ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIX. No. 13. NEW YORK, SATURDAY, SEPTEMBER 29, 1906. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE, L. W. MARSHALL, Manager, . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE, M. W. BARBER, Mgr., DELTA BLDG., 10 Post Office Sq.

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
The Fire-proof Dynamo ... 489
Color Difficulties in Photometry ... 490
High-Efficiency Radiators ... 491
Our Cities of Evil Smells ... 491
Fuel, Water and Gas Analysis for Steam Users, by John B. C. Kershaw ... 492
A Letter from Manchuria ... 497
Electric Operation of the Teltow Canal, by Frank C. Perkins ... 498
Color Phenomena in Photometry, by J. S. Dow ... 501
Length of Wave and Speed of Propagation of Electrical Phenomena ... 506
The Relation of the Alternating-Current Motor to Central-Station Power Business, by E. W. Lloyd ... 506
Montreal Light, Heat and Power Company's Soulanges Canal Power Station ... 508
Convention of the Illinois Electrical Association ... 509
The Opening of the Camden-Atlantic City Line of the West Jersey and Seashore Railroad ... 509
Meeting of the Colorado Electric Light, Power and Railway Association ... 509
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 510
METHODS OF GETTING NEW BUSINESS ... 512
An Interesting Emergency Application of Electricity ... 516
The Electrical Trades Exposition Company ... 516
Staff Additions for Sanderson & Porter ... 516
Illuminating Tests ... 516
The Association of Edison Illuminating Companies ... 516
INDUSTRIAL SECTION:
The Balanced-Draft Gas-Producer Furnace ... 517
The Improved "Dow" Adjuster ... 518
New Electrical Engineering Company ... 518
Sturgess Water-Wheel Governor ... 518
An Improved Type of Lever Switch ... 519
The Dean Hook Switch ... 520
Crude and Fuel Oil Generator Sets ... 521
Electric Equipment for the Hudson Company's Tunnels ... 521
Automatic Motor-Controlling Devices ... 521
Vacuum Drying and Impregnating Apparatus ... 522
CURRENT ELECTRICAL NEWS ... 523
Record of Electrical Patents ... 529

Copyright, 1906, by Electrical Review Publishing Co.

THE FIRE-PROOF DYNAMO.

The weak point in electrical machinery is almost always the insulation. It is true that the direct-current dynamo is somewhat handicapped by its commutator, but improved design has reduced the troubles at this point very greatly, and the commutator itself may be constructed so as to withstand a great deal of hard service. But both alternating and direct-current machines must employ some insulating material, and this is generally of necessity of such a character that it is seriously damaged, if not destroyed, by overheating. The commonest insulating materials are cotton and flax, which become carbonized at temperatures not much above that of boiling water, and they thus lose the very property for which they are used. In larger machines or those constructed for excessively high voltages the cotton insulation may be supplemented or even replaced by other materials such as tubes of fibre or of mica. But fibre and even the cement used for building up tubes of small pieces of mica can not withstand indefinitely high temperatures, so that a form of construction which does not become too hot must be adopted. By means of various devices, such as ventilating systems or ways of arranging the materials of the machine, it is possible to dissipate a great deal more energy from a given weight of material or from a given surface than we could a few years ago. In this way we have succeeded in decreasing the weight and the cost of our apparatus, but we are not yet independent of temperature, for an overloaded machine will still become dangerously hot.

The difficulty encountered in insulating electrical machinery lies in the fact that a good electric insulator is also a good heat insulator, and the very process of construction employed to prevent the current from taking undesired paths is one well calculated to prevent the dissipation of heat, and therefore the inner layers of a winding of insulated wire in which energy is being dissipated as heat will be at a temperature considerably higher than that of the outer layers. One of the most successful means of combating this difficulty is the use of ventilating ducts, which cause a circulation of air through the machine. Another, of more recent date, also of very great importance in the construction of machines, is the use of strip windings. By this means a coil having a sufficient number of turns, with a conductor of the proper cross-section, may be made but one layer deep; and when this conductor is bare, as is very frequently the case, every foot of it is exposed to the air. This solution may be compared with the lamination of the armature core. A good path for heat conduction is provided, but a poor path for electrical conduction across from layer to layer, just as in the

armature the laminations provide good magnetic paths in one direction, but poor electrical paths in another.

Other attempts have been made to render coils less liable to injury from overheating. The coils, after being wound, may be saturated with some insulating material and baked so as to convert them into a solid mass. This method of treatment has been employed in various ways, but has not come into general use for windings, and though of considerable value, this method would not make a machine entirely fire-proof, for the insulation of the wire will eventually break down under the continued high heat, resulting possibly in a short-circuit.

Another method of insulation more recently tried makes use of the insulating property of aluminum oxide. This metal is used instead of copper, and is treated so as to take on a coating of oxide. The wire thus treated—otherwise bare—is wound up in coils without any other provision being made for insulation. For high voltage some precautions are necessary to secure a sufficiently thick coating of the oxide, but for ordinary voltages no treatment at all is required. The advantage of this method, beyond the reduction in cost which is said to result from it, will lie in the fact that the insulating coating is thin, and there is but little space not filled by the metal. If square wire be employed, as suggested, in some cases, the coil becomes almost a solid mass of metal and oxide. Such a coil is not only able to withstand fairly high temperatures, but should be a fairly good dissipator of heat, for although the insulating coating is itself a non-conductor, the fact that there is but little air space left between adjacent wires would facilitate the conduction and dissipation of heat. It is a question whether a coil wound in this way could stand very high temperatures, such, for example, as would drive off the water of crystallization of the oxide coating. Even should this happen, the pure oxide might be a fairly satisfactory insulator. The ideal construction is one which would enable the coils to be used even if red hot, although, of course, other considerations make it undesirable to work at such temperatures. The question of efficiency is an important one, and this is bound up in that of temperature.

COLOR DIFFICULTIES IN PHOTOMETRY.

The work of the photometrist is not easy, for he has many difficulties to contend with, yet the one which occasionally gives the most trouble is that involved in making a satisfactory comparison between two sources of light which differ in color. Given two lights of the same kind and satisfactory apparatus, almost any one can make some sort of comparison, though, for consistent results, practice and skill are required. But when a comparison is sought between two lights differing considerably in color, even the most expert photometrist has difficulty. An interesting article on this subject by Mr. J. S. Dow appears on another page of this issue. Mr. Dow has made a somewhat extended investigation of the matter and has produced some valuable results to which attention may well be called.

The investigation was divided into four parts, according to the cause of the uncertainty. These were: the difficulty experienced in forming a judgment in the case of differently colored lights and the possibility that the judgments of different people may not be the same; the fact that the apparent relative brightness of two surfaces illuminated by light of different colors depends upon the part of the retina on which the image of them is received; the Purkinje phenomena; and the possibility that when mirrors are made use of the coefficient of reflection may not be the same for differently colored lights.

Taking up these points in the reverse order it is found that although there is probably some difference in the coefficient of reflection of the mirrors, that this, with the mirrors used in the investigation, was of little importance. For mirrors made in other ways it might, however, be a source of considerable error.

The Purkinje effect, it was found, may give rise to considerable error if low intensities of illumination be employed. This is that peculiar phenomenon which causes a surface of one color to appear brighter than that of another when both are brightly lighted by the same source, while the second will appear brighter than the first when the intensity of illumination is diminished. This effect is exceedingly complicated, and errors due to it may be avoided by maintaining a good illumination of the surfaces compared.

The second source of error investigated is one which may become troublesome. In a comparison of two lights of different color different results may be obtained if the images of the two surfaces are formed on different parts of the retina. In fact, it was found that a considerable error may be introduced merely by moving the eye nearer to or further away from the photometer screen, thus increasing or decreasing the size of the image on the retina.

The first source of difficulty—that one involving a difference of judgment with different persons—is perhaps the most important. There would seem to be no way of getting around it. Although it was found that one observer, after some training, could obtain fairly consistent results when working straight ahead, even he was apt to judge differently if he allowed time to intervene between his readings.

The whole problem, like some other problems in photometry, seems to be due to an attempt to do something next to impossible. In the question of rating lamps no satisfactory decision has been made—satisfactory, that is, to every one—because those manufacturers making highly efficient lamps want a rating which will bring out this desirable quality, and those who make a feature of a peculiar distribution of illumination want this phase emphasized.

But the comparison of lights of different color involves a more fundamental difficulty. Who is to say whether a green light is brighter than a red, and what is meant by brightness? It is only a comparative term. Many persons are so color blind that it would be impossible for them to make any fair comparison, and possibly all of us are somewhat affected in this way. If some test were employed involving the amount of illumination necessary for vision there might be some meaning in

a comparison, but it is doubtful if even such a test would give consistent results, for the physical condition of the eye, whether fresh or tired, would have much to do with it. If a comparison could be made satisfactorily between lights having different colors this would be exceedingly useful, but it is questionable whether there is much value in such comparisons as they are now made. One might as well try to judge between the relative goodness of an apple and a peach. If either of the two is very bad there is no difficulty in making a choice, but when both are good, who is to say which is the better? Every one, according to his preference, will take the apple or the peach; and, according to his eyes, will find the reddish or the greenish light more satisfactory.

HIGH-EFFICIENCY RADIATORS.

Although a number of explanations have been given for the apparent greater efficiency as radiators of light of certain bodies, no one of these has received unquestioned support. One which is frequently given is that these bodies have the property of selective radiation; that when heated they radiate a larger proportion of the energy given off in certain wave-lengths than do other bodies heated to the same temperature. Another suggestion is that by some sort of catalytic action the temperature of the source of heat is raised by the presence of the radiator. Other ideas have been expressed, such as unstable oxidation or luminescence, or other vague phrases, which, since they go no farther, are not explanations.

This subject was discussed in an interesting manner by Mr. James Swinburne at the recent meeting of the British Association for the Advancement of Science, who sought for an explanation of the great luminous efficiency of gas mantles. Mr. Swinburne touched upon the various explanations which have been offered, dissenting from all but one, which is that the blue Bunsen flame employed for heating the mantle is really very much hotter than is generally supposed, and therefore the mantle is really raised to a higher temperature than would be suspected. This idea is attributed to Ram, and to support it it is said that temperature indications of the Bunsen flame made by thermometers or pyrometers can not be depended upon, because these bodies are radiating, and must, therefore, be absorbing heat from the flame, and, as a consequence, are at a lower temperature than the flame. The gas mantle is, however, a white body and should, therefore, be a poor radiator, and, as a consequence, should come more nearly to the normal temperature of the flame. The efficiency of the luminous radiator increases enormously with the temperature, so that this explanation, if supported by facts, might be sufficient to account for the efficiency of the mantles; but, as is pointed out, it has not yet been shown that the radiator is a white body at the temperature of the flame. The mantle is formed in general of two substances —thoria and ceria. The former is used to produce the radiation, and the latter because it is permanent at high temperatures. In fact, where two or more materials are used in constructing the mantles the perplexity of the problem increases considerably, for changing their proportions will change considerably, and perhaps unexpectedly, the amount of light emitted. If the mantle be a poor radiator it will be at a high temperature, but will radiate little energy. On the other hand, if it be a good radiator it will necessarily be at a lower temperature, but may radiate more energy. In the first case, of the energy radiated the proportion which is luminous will be greater than in the second, but the total amount of luminous energy may be greater in the second case, and while it may be less efficient as a radiator it may be more efficient as a mantle—that is to say, it may convert into luminous rays a greater proportion of the heat developed by the flame.

It would seem that the subject might be studied with greater ease by means of the electrically-heated radiators of this kind, such, for example, as the Nernst glower. In this case the supply of energy to the glower may be made independent of its temperature, and may be controlled at will. With the gas mantle, on the other hand, the actual condition of the mantle itself determines not only the amount of energy which it gives out, but the amount of energy which it takes from the flame; so that an investigation made under such conditions would naturally be difficult. A number of investigations with the electrically-heated glower have been carried on, one of which was referred to not long since, it being at attempt to determine the temperature; and the investigator, Mr. L. W. Hartman was much surprised to find that it was apparently considerably lower than previous work had indicated. These results do not agree with Ram's explanation, as they point rather to some sort of selective radiation; but, as Mr. Swinburne says, though simple explanations appeal to him, "very simple explanations are very often wrong."

OUR CITIES OF EVIL SMELLS.

What a pity it is that with all our progress in building up cities and developing means of transportation and distributing power that we can not get away from certain old nuisances, and have brought about some new ones almost as bad! One can hardly make a long trip through a large city without finding some street badly torn up and the air for blocks around almost unbreathable from the horrible stench of gas. We have been afflicted with this nuisance for over half a century.

Another annoyance of a less violent type, but perhaps as bad because it is more widespread, is the disgusting trail left behind by the gasolene automobile. There is no need of a blood-hound to track the course of one of these modern vehicles through a city. Every one may do so for himself, though if his olfactory nerves are at all sensitive he is more apt to seek a different route. Why can not the automobile makers do something to mitigate this annoyance?

These are only two of the various offending odors which seem to be inseparable from urban life. Many of us, perhaps, have noses which have become so deadened through constant exposure that we no longer notice them, but those who are fortunate enough to be able to live where the air is purer suffer from the plague of smells every time they enter a city. We are agitating for clearer air, and we have given some attention to reducing noise. Let us also give some thought to securing sweeter air to breathe.

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW.

III—The Calorific Valuation of Fuels.

The laboratory calorific valuation of fuels is carried out by burning a weighed quantity of the dry fuel in a confined space surrounded by a known volume or weight of water, and by noting the increase in temperature of the latter, due to the combustion of the fuel. A very large number of calorimeters have been designed and employed in the laboratory for carrying out this test, but all of these may be brought into three classes, according to the character and method of supplying the necessary oxygen.

Either the oxygen is brought to the fuel in the form of a chemical compound, or in the free state; and calorimeters using gaseous oxygen for combustion of the fuel are differentiated by the pressure at which this oxygen gas is supplied, the Fischer and Mahler bomb calorimeters being the leading representatives of these two different types. In the following pages one calorimeter only of each class will be described, and the method of use will be explained in considerable detail.

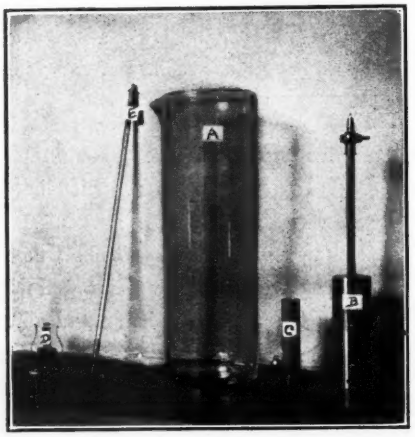


Fig. 9.—Lewis Thompson Calorimeter.

Of Class i, the Lewis Thompson calorimeter has been selected. Although the results obtained by this calorimeter has been often discredited, when used with the modifications suggested by the author it yields concordant results with certain classes of fuel.[2]

Of calorimeters using oxygen gas at normal pressure, the "Darling" calorimeter has been described; while of Class iii, the Mahler-Donkin bomb calorimeter has been dealt with.

[1]All rights of reproduction and translation are reserved. Copyright, 1906, by John B. C. Kershaw.

[2]Scheurer Kestner's tests with this form of calorimeter confirm this opinion.

In each case the descriptions and details are based upon lengthy trials in the author's own laboratory.

General Regulations for Calorimetric Work.

Wherever possible a room heated by hot water pipes or by hot air, and kept

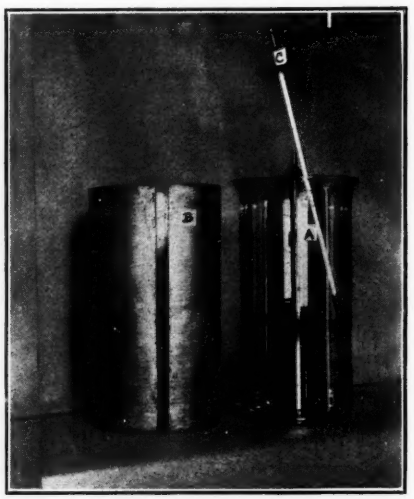


Fig. 10.—Modified Form of the Lewis Thompson Calorimeter.

at the same temperature day and night, should be used for calorimetric work. Rooms heated by open fires vary greatly in temperature at different times of the day, and this difference in temperature of the air causes difficulties in the calorimetric work. The whole of the calorimetric apparatus should be kept under cover in the same room, and it should be thoroughly cleaned and dried after each test. The water used in the tests should be drawn at least twenty-four hours before required, and stored in large bottles in the calorimeter room, so that both the apparatus and water may be at the air temperature of the room when required for use. Direct sunlight must not be allowed to fall on the apparatus during the tests; and when choice is possible a room with a north or east aspect is preferable to one facing south or west. Temperatures should be taken with standardized mercury thermometers read off with a magnifying glass. All temperatures taken during the tests should be noted down on paper with the time at which they were recorded; omission to form this habit will generally lead to spoiled tests at some later date.

In the winter months in laboratories heated by open grates, the tap water, if the other supply has failed, is often many degrees colder than the air of the laboratory. In such cases it will be found that the large volume of water required for filling the calorimeter can be speedily raised in temperature by the radiated heat from a coal fire. The water is placed in large pale green glass bottles eighteen inches from the bars of the grate, and the bottles are turned round at intervals of fifteen minutes. This method is less troublesome and less likely to lead to breakage than heating over the fire in a kettle or over the lamp in beakers.

When working with only half a gramme of fuel, radiation losses can be ignored, and water at the laboratory temperature may always be employed.

The Lewis Thompson Calorimeter.

Fig. 9 shows the separate portions of the Lewis Thompson calorimeter, as usually employed. A is a large glass cylinder holding 2,000 cubic centimetres of water—when filled to the mark; B is a copper cylinder open below and closed above by the copper pipe and tap—through which the final gases of the combustion are allowed to escape; C is a small copper cylinder in which the combustion of the fuel actually occurs; D is the holder for the same; and E is a mercury thermometer graduated in tenths, and reading from zero to forty-five degrees centigrade.

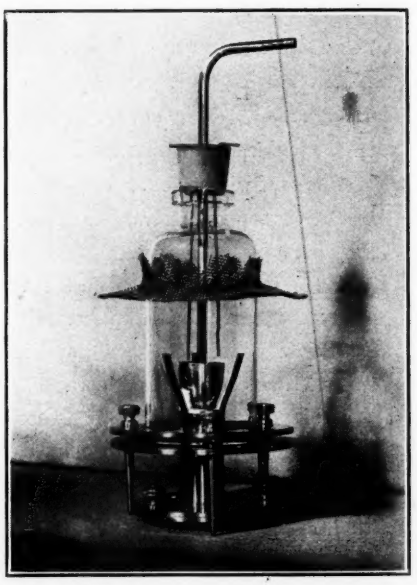


Fig. 11.—Darling Calorimeter.

The method of use is as follows: Two grammes of the finely powdered and dried sample of coal, prepared as described in Article ii, are weighed out and intimately mixed with twenty-two grammes of the oxygen mixture.[1] This mixing is best carried out upon a sheet

[1]This mixture contains three parts of potassium nitrate to one of potassium chlorate, and must be quite dry.

of glazed white paper, and must be continued until no black specks are visible, and the mixture is of a uniform gray color. The mixture is now transferred to the copper cylinder C, with the aid of a dry funnel having its leg cut off, and is pressed down by means of a glass rod having a flattened glass button on its end.[1] When the whole of the mixture has been transferred to C, this is placed in the holder D, a few strands of fuse are embedded in the top of the mixture, the projecting free ends are ignited, and after quickly covering with the copper cylinder B, the whole is placed in the vessel A, containing 2,000 grammes of water, the temperature of which has been most carefully noted. If the ignition and combustion are successful, the test is now nearly completed, for after the whole of the combustion gases have bubbled up through the water in A, it is only requisite to open the tap at the top end of B, allow the water access to the cylinder C, and to thoroughly mix the water in A by plunging the cylinder up and down in it, to obtain the final

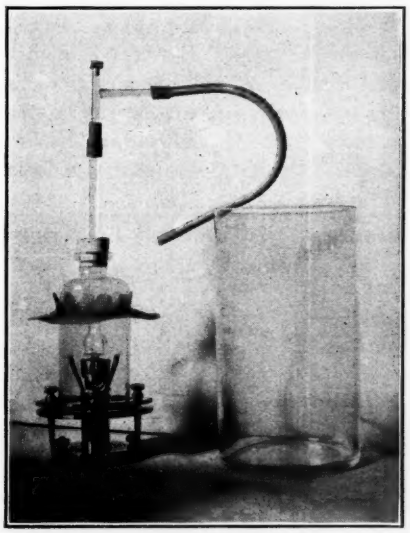


FIG. 12.—ANOTHER FORM OF THE DARLING CALORIMETER.

reading of the thermometer which gives the increase in heat due to the combustion of the two grammes of fuel.

The calculation which yields the calorific value of the fuel is then simply obtained by use of the equation $C = \frac{(2{,}000 + x)\ t}{2}$ in which C = calorific value; x = the water equivalent of the apparatus in centigrade units and t = the gain in temperature. The value of x for this apparatus, and in fact for all forms of calorimeter, is best obtained by testing a standard sample of fuel or pure cellulose, of known calorific value, and by using x as the unknown in the above equation in place of C, the value of which can then be inserted.

[1] This is easily made by heating the end of a glass rod to redness and by pressing the hot end on a flat surface of cold iron.

The improvements in the Lewis

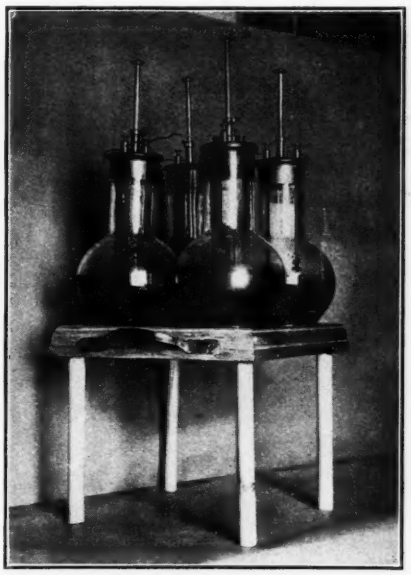


FIG. 13.—BATTERY OF BICHROMATE CELLS FOR FUEL IGNITION PURPOSES.

Thompson calorimeter, and method of use devised by the author, are as follows:

1. The weight of water used for each test is increased to 3,000 grammes by use of a larger vessel; see A, Fig. 10.

A thin Jena glass beaker replaces the thick vessel shown in Fig. 9. This change lessens the rise in temperature and thus diminishes radiation losses.

2. Radiation losses are further minimized by use of the tin cylindrical shield B in Fig. 10 which surrounds the beaker, and provides a non-conducting air jacket between the water and the outside air.

3. A copper gauze ring is provided to fit on to the copper cylinder and nearly touch the beaker at all points. This breaks up the bubbles that pass through the water on making a test, and causes the waste gases to be better cooled.

4. The usual thermometer is replaced by one which allows the temperature to be read one one-hundredth of a degree centigrade. This improvement in reading off the increase in temperature must, of course, be accompanied by increased care in the weighing, mixing and measuring operations. A one-litre flask is used for measuring the water used for the test.

5. The oxygen mixture is dried before use, one hour at 110 degrees centigrade for each test) and the amount to be employed is calculated from the combustible actually present in the fuel. The formula used for this calculation is $W = \frac{100 - x}{4}$ in which W = the weight of oxygen mixture required for two grammes of the fuel, and x = the percentage of ash in the dry sample.

6. The mixing of the oxygen compound with the two grammes of fuel and charging of the copper cylinder with the same are most carefully carried out, and no loss of fuel is allowed to occur in this operation. The cylinders are numbered according to their capacity as measured by water contents, and as far as possible it is planned that the fuel and oxygen mixture shall fill the cylinder to within three-quarters inch of the top. The precise degree of pressure it is necessary to employ in filling the cylinder with this mixture can only be learned by experience; if too loosely packed the combustion is too rapid; if too tightly packed the charge will probably become extinguished before all is burnt. A combustion should last one minute.

7. The ignition fuse is made of four strands of lamp wick, one inch in length, dipped in potassium nitrate solution and

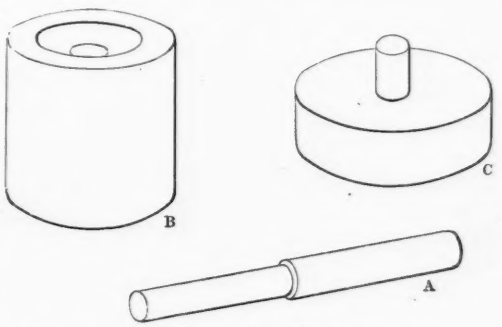


FIG. 14.—MOULD FOR FUEL BRIQUETTES.

dried. The four strands are twisted together, and one-quarter inch of the ends are then spread out in the form of feet, and the little igniter is placed upon the top of the charged cylinder with the ends lightly embedded in the mixture, which must be left loose and porous at this place.

8. The water equivalent of the apparatus is determined by actual trial with a standard fuel as already described.

9. The copper vessels, B, C, and D, in Fig. 9 are placed in the calorimeter after C is charged, and the temperature

is read when equilibrium is established. The tap of B must, of course, be closed during this period. The charge is then ignited by withdrawing and disconnecting B, C, and D for a very brief period of time.

Operating as described in 6 and 7, the author is seldom troubled with failures to ignite, or with incomplete combustion.

Using this modified form and method of working with the Lewis Thompson calorimeter, the author has obtained results which are within one per cent and two per cent of the calculated values of the fuel, when testing bituminous fuels containing over twenty-five per cent of volatile matter. The conditions under which the test is made must, however, be kept as far as possible the same as those under which the water equivalent is determined; and any wide variation in these conditions will lead to discrepancy in the results. With semi-bituminous and anthracite coals, the Lewis Thompson form of calorimeter yields, however, unsatisfactory results, owing to the amount of unconsumed carbon. Coke and peat also can not be burned in this calorimeter, so that its field of usefulness is somewhat narrowed and restricted.

For correct calorific tests of all these classes of fuel, either of the calorimeters about to be described must be used.

THE DARLING CALORIMETER.

The Darling calorimeter is based upon the principle of combustion in a current

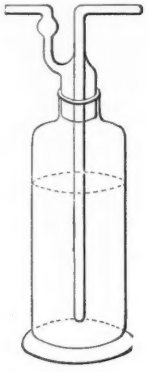


Fig. 15.—Wash Bottle for Oxygen Supply.

of oxygen gas at normal pressure, and the apparatus is a modified and improved form of the well-known William Thomson calorimeter. Fig. 11 shows the essential parts of the Darling calorimeter. A small nickel or platinum crucible, one and one-half inches high by one inch in diameter, is held by brass arms in the centre of the perforated brass base-plate of the apparatus. A flanged glass bell-jar provided with a rubber cork, carrying a brass oxygen supply pipe and two copper conducting wires, is clamped to the base-plate by means of rubber rings and by a brass ring plate held in position by screws or nuts. It is advisable to use a rubber ring above and below the glass flange on the bell-jar to avoid breaking this—when tightening the milled head

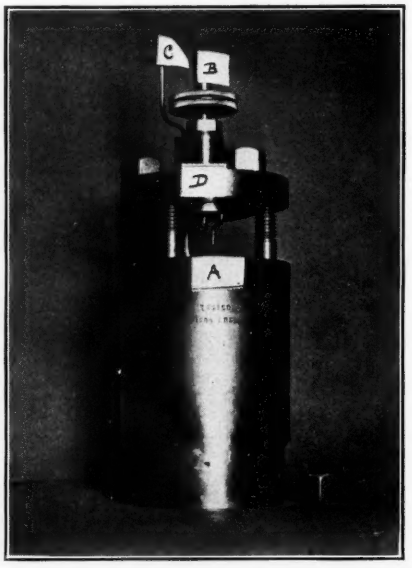


Fig. 16.—Mahler-Donkin Bomb Calorimeter.

screws. A brass gauze ring is shown in position on the bell-jar in Fig. 11, but this is an addition to the original apparatus. Fig. 12 shows another form of the apparatus in which the brass oxygen supply tube is replaced by a tube of hard potash glass widened out to form a cup at its lower end, and connected above to the oxygen cylinder or gas-holder by a glass T piece. In the first form of the Darling apparatus, ignition of the charge occurs by means of a fine platinum wire fixed between the lower ends of the two copper conducting wires, which are themselves connected to four bichromate cells or to some other source of electrical energy. Fig 13 shows a convenient bichromate battery—made up of four pint cells. In the second form of apparatus, ignition occurs by means of a small piece of glowing charcoal (.01 to .02 gram) this being dropped down the oxygen supply tube by removing the small cork which closes the vertical end of the glass T piece. This method of ignition is preferable to that recommended by Darling as the use of sulphur for igniting the charge has many advantages. In both forms a sheet tin cylinder surrounding the glass vessel diminishes the reduction losses and is a useful addition to the original apparatus.

The method of carrying out a determination with the Darling calorimeter is as follows:—1,400 grammes of water are measured carefully into the glass vessel shown in Fig. 12, using a one-litre flask and graduated cylinder for this purpose. From half to one gram of the dry sample of fuel is weighed out into the crucible; this is placed in its holder and the apparatus is clamped together as shown in Figs. 11 and 12. If electric ignition is to be employed the ends of the two copper conducting wires are joined by a short piece of very fine platinum wire, the loop of which is made to dip under the surface of the fuel contained in the crucible. It is wise to try the effect of the current on this wire before clamping up the apparatus for each test, since at times the bichromate battery requires cleaning. The oxygen supply tube is now connected to the gas-holder or cylinder containing oxygen, and a slow but steady current of oxygen is passed through the apparatus, which is now ready for immersion in the glass vessel containing the water.

When immersed, the water should reach up to the neck rim of the bell-jar but not above it, and the air which is being displaced from the interior of the apparatus by oxygen should bubble up through the water in small bubbles, from

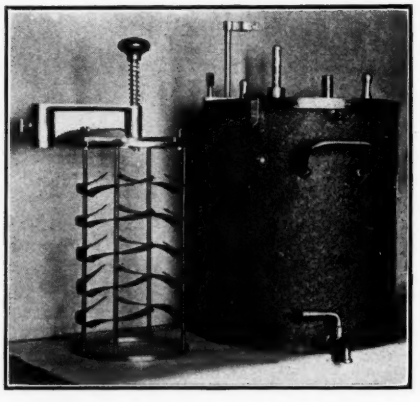


Fig. 17.—Water Vessel and Mixing Paddles.

all portions of the perforated base-plate. The temperature of the water is next taken at two-minute intervals, and when the mercury in the thermometer has become stationary, the stream of oxygen is made much more rapid, and the coal is ignited. If charcoal be used for ignition, the small weighed particle is held over a lighted match until it commences to glow, when it is dropped down the oxygen tube. When the coal contains much vola-

tile matter, there is some danger of explosion during the early part of the combustion, and considerable skill and experience in the management of the apparatus are necessary, to attain perfect combustion. It is advisable therefore to start with the lower end of the oxygen supply pipe high up in the bell-jar, and to have a very rapid current of oxygen when the coal (as shown by the approximate analysis) contains over thirty per cent of volatile matter.

When the greater portion of the volatile matter has been distilled and burnt, only coke remains in the crucible, and the oxygen tube can be pushed down gradually, until it is below the crucible rim. The combustion can be finished with the lower end of the oxygen supply tube nearly touching the glowing residue in

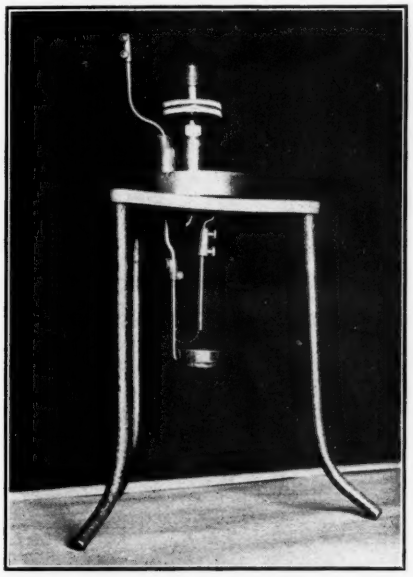


FIG. 18.—BOMB COVER WITH PLATINUM DISH AND IGNITION WIRE IN POSITION.

the crucible. When the tube shown in Fig. 10 is employed for supplying the oxygen to the fuel it is necessary to work this from side to side, in order to spread the stream of oxygen over the whole of the fuel and residue.

The combustion is finished when the residue in the crucible ceases to glow, but the crucible itself should become red-hot during the combustion, and in order to avoid premature loss of heat it is advisable to support the crucible upon an asbestos tray. The current of oxygen gas through the apparatus is then slackened, and the temperature of the water is noted every half minute, until a fall occurs. According to the inventor, four and one-half minutes should suffice to burn one gram of fuel, but the author has never succeeded in carrying out a test in this time. The calculation is made as before, by use of the equation $C = \frac{(1{,}400 + x)\ t}{w}$; in which C equals the calorific value of the fuel, t equals the gain in temperature of the water, w equals the weight of fuel used, and x is the water equivalent of the apparatus. Although a value for x is given with each apparatus sold, it is far better and safer to determine it by use of a standard combustible, such as cellulose or pure carbon, as described in the previous section of this article.

The Darling calorimeter only yields entirely satisfactory results with fuels low in ash and in volatile matter. When fuels containing a high percentage of volatile matter are burned in the Darling apparatus there is a tendency for some of the volatile hydrocarbons to escape unconsumed; and when fuels high in ash are tested, there is a tendency for portion of the fixed carbon to remain unburned in the crucible. In the case of coke, this unconsumed carbon may amount to ten per cent of the total combustible matter.

The first of these difficulties may be overcome by mixing one-third of its weight of china clay with the fuel before burning in the calorimeter. This remedy, however, is only partial, for it increases the amount of ash remaining in the crucible, and therefore the risk of some of the fixed carbon remaining unconsumed.

The second difficulty can only be overcome by making small pellets or briquettes of the fuel sample, and using these for combustion in the calorimeter in place of the finely powdered sample. Fig. 14 shows the pellet mould used by the writer for this purpose. Two grammes of the finely powdered sample are mixed in a small agate or glass mortar with one cubic centimetre of a one per cent solution of pure gum-arabic in water. Very bituminous fuels can be moulded without adding gum-arabic. This paste is then moulded into three cylinders in the mould shown. Each of these is cut while still moist into two halves with a sharp knife, and the six little pellets of fuel obtained in this way are then dried at 230 degrees centigrade for one hour in the air-bath. Two, three or four of these pellets, according to the weight required, are then used for the calorimetric test, which is carried out as already described.

When fuels containing less than ten per cent of volatile matter are tested in the Darling calorimeter, some difficulty will be met with in the absence of an electric current in causing them to ignite, for neither charcoal nor sulphur will always suffice to start the combustion. The best plan in such cases is to use a small weighed portion of some previously tested bituminous coal, either making a mixed pellet of the two coals, or using both in the powdered form and sprinkling a little of the standard bituminous fuel on the surface of the other in the platinum crucible. The different calorific value of the added fuel must of course be allowed for, in calculating the result of the test.

By using only half a gramme of fuel and a thermometer reading to one one-hundredth of a degree centigrade, the time required for burning the fuel and the gain in temperature can be reduced one-half, and the errors due to radiation losses correspondingly diminished. When working with this small

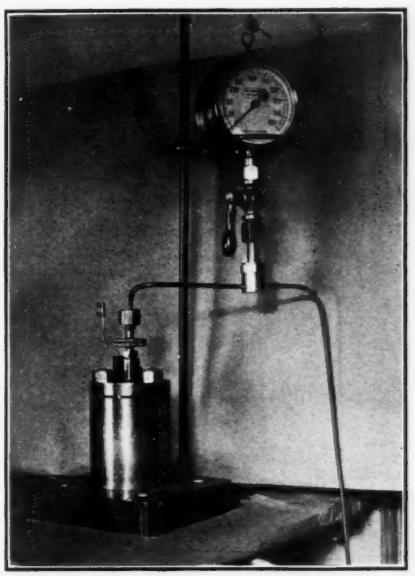


FIG. 19.—BOMB, WITH OXYGEN SUPPLY PIPE CONNECTED.

amount of fuel, very careful and accurate weighing and measurements are required to obtain reliable results. The combustion of the fuel can be effected much more quickly when the fuel is in briquette form, since the current of oxygen gas can be increased greatly without danger of blowing the fuel out of the crucible.

The oxygen used in working the Darling apparatus should either be stored in a gas-holder over water, or should be passed through a glass tower filled with pumice soaked in water, in order that it may take up before use all the water it can carry at the temperature of the laboratory.

It is also useful to have a wash bottle through which the oxygen bubbles in-

serted between the gas-holder or cylinder and the calorimeter; as in this way the speed of the current can be more easily noted and controlled. Fig. 15 shows a suitable form of wash bottle.

When used with the precautions described above, the Darling calorimeter can be made to yield accurate results with all classes of fuel. But as usually employed, the combustion is in many cases imperfect, and unless allowance be made for the unburned hydrocarbon gases or fixed carbon, the calorific values obtained are too low.

THE MAHLER-DONKIN BOMB CALORIMETER.

Figures 16 to 21 show the component parts of the Mahler-Donkin bomb calorimeter. The combustion of the fuel in this calorimeter is carried out in oxygen gas, at from 200 to 400 pounds' pressure. Fig. 16 shows the most important portion

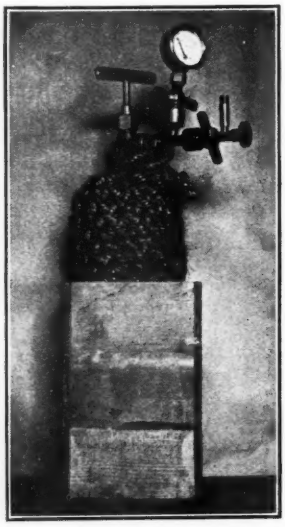


FIG. 20.—OXYGEN CYLINDER WITH VALVE AND PRESSURE GAUGE.

of the apparatus, namely the bomb. This is a heavy gun-metal cylinder (A), provided with three screwed stud pins for bolting down the cover D, and lined inside with gold to protect the metal from corrosion by the acids formed during combustion of the fuel. The cover is provided with a milled head screw valve B for regulating the inlet of oxygen gas; with an insulated conducting wire C which runs through the cover and terminates below, and with three heavy nuts for bolting down the cover on to the cylinder. Thin lead wire is used to make the joint between the cylinder and cover, and the bomb is tested up to 1,500 pounds' pressure before leaving the maker's works. Fig. 17 shows the rest of the apparatus: namely a water container and paddles for quickly obtaining a uniform temperature. A water-jacket and also an air-space surround the inner vessel containing the measured volume of water and the bomb, and the mixing paddles fit round the latter. These paddles can be worked up and down or in a circular manner, by the wooden knob which projects six inches above the water container when all the apparatus is fitted together. The ignition of the fuel occurs by electric heating, a fine platinum wire being used as bridge between the lower ends of the two electrodes fixed on to the bomb cover. Fig. 18 shows the cover alone supported on a tripod stand, with the small platinum dish and the platinum wire ignition loop. It is well to make a trial test of the electrical connections in this position, since if the platinum wire does not heat to redness it is comparatively easy to find out the cause, whereas later on, when the cover is bolted on to the cylinder and the bomb is immersed in the water, a failure to ignite causes much trouble. Platinum wire must be used for ignition purposes. The author uses the finest made, of which twelve inches weigh two grains. Iron wire can not be used, for it produces fused iron oxide on ignition and this speedily corrodes the gold plating of the bomb at those places where it falls. A small platinum dish, one inch in diameter and three-eighths-inch deep, is preferable to a crucible for holding the fuel, since it is easier in this case to arrange that the platinum loop shall dip in the fuel. For this purpose the wire is wound seven or eight times around the straight electrode, and the loop is lengthened as required by pulling one or more of these coils down with a pair of small forceps. The weight of fuel used for carrying out a test with the bomb calorimeter varies from .40 to 1.0 gramme. The smaller the quantity of fuel used, the smaller is the rise in temperature of the water, and the less is the time required for completing a test, both of which reduce the error due to radiation losses. On the other hand, this method of working demands great care in all weighing and measuring operations; and some degree of skill in manipulating the apparatus is necessary before correct results can be obtained when working with .5 gramme of fuel.

After weighing out the fuel roughly into the platinum dish, it is advisable to heat the same for one-half hour in the air-bath at 230 degrees centigrade, and to reweigh carefully before making the test with it. The dish is then transferred to the holder under the cover, the platinum wire-ignition loop is lowered carefully until its lower edge just dips into the fuel, and the cover is placed on the bomb and bolted down. Ten cubic centimeters of distilled water, to absorb the acid gases produced by the combustion, have been previously measured into the bomb. Great care must be taken not to jerk or jar the bomb while bolting on the cover, since this may cause a displacement of the ignition wire and a failure to ignite later on. A wooden block holder is provided with the Mahler-Donkin bomb, which can be screwed to the laboratory working bench; this greatly facilitates the screwing tight of the cover. The next step is to fill the bomb with oxygen, and the necessary connections to the oxygen cylinder are shown in Fig. 19. A pressure-gauge, recording up to 400 pounds, is

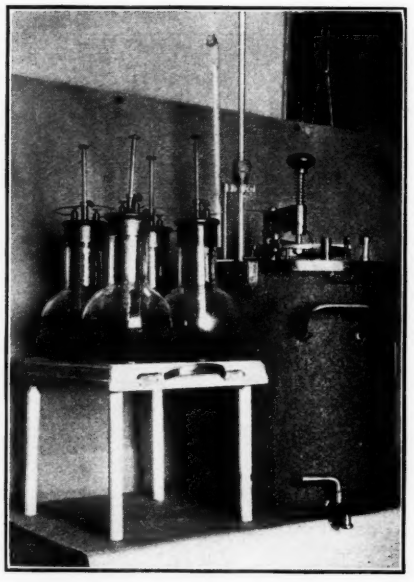


FIG. 21.—THE MAHLER-DONKIN BOMB CALORIMETER READY FOR IGNITION.

provided between the oxygen cylinder and the bomb, and a thick-walled copper tube, provided with flanged ends and nuts, is employed to connect this with the cylinder and bomb. Small lead washers assist in making these joints gas-tight. It is well to have a fine screw-regulating valve and a pressure-gauge reading up to 120 atmospheres attached to the oxygen cylinder, as shown in Fig. 20. Otherwise it is difficult to control properly the flow of gas into the bomb, and too rapid a rush of oxygen may cause some of the finely powdered fuel to be blown out of the platinum dish. The gas must be admitted to the bomb slowly. The amount required, as indicated by the pressure, varies with the amount of fuel used. For half a gramme of fuel, a pressure of 220 pounds suffices; for one gramme of fuel,

400 pounds is necessary. With this higher pressure there will be some difficulty in keeping all the joints tight, but slight leaks may be ignored. In the Mahler-Donkin bomb, as originally designed, a considerable loss of pressure and of gas occurred also on closing the milled head-screw valve on the top of the bomb, since to close this it was necessary to loosen the screw-nut connecting the oxygen supply pipe above it. The author has, therefore, had a small back-pressure valve inserted in his bomb, in the portion of the cover marked B, Fig. 15, and this comes into action and closes the exit pipe as soon as the exterior pressure is relieved. This is a most useful addition to the earlier design.

The milled head-screw valve is now closed, the bomb disconnected from the supply, and the opening in the top of the bomb is closed by the screw-nut shown in the foreground in Fig. 16. The bomb is now carefully transferred to the water vessel which has been previously filled with 2,500 cubic centimeters of water at the laboratory temperature, the mixing paddles are placed in position, and the conducting wires, from a bichromate battery of four cells, or from some other source of electrical energy (two amperes at twelve volts are required), are connected to the terminals on the bomb. The screw-nut, projecting above the water in the calorimeter vessel, is used as the second terminal on the bomb. The mixing paddles are now worked gently until the thermometer dipping in the water of the inner vessel ceases to rise or fall, and the fuel is then fired by depressing for three seconds the last of the zinc plates of the bichromate battery. Within half a minute, if the ignition has occurred properly, the thermometer will begin to rise, and the mixing paddles are again worked steadily until the mercury again becomes stationary. The final temperature is now recorded, and the test is finished.

For work with this calorimeter the author uses a specially made mercury thermometer, twenty-four inches in length, graduated in fiftieths and ranging from ten degrees centigrade to twenty-five degrees centigrade. With the aid of a magnifying glass one one-hundredth of a degree can easily be read on this thermometer.

The calculation is carried out as before by aid of the equation: $C = \frac{(2{,}500 + x)\,t}{w}$ in which C represents the calorific value, x the water equivalent of the apparatus, t = the gain in temperature and w = the weight of fuel used in grammes. The value of x is best determined as before, by making a test with pure cellulose naphthalene or carbon, and by inserting x as the unknown value in the above equation. Pure naphthalene has a calorific value of 9,692 calories, pure cellulose of 4,200 calories and pure amorphous carbon of 8,137 calories.

The Mahler-Donkin bomb yields accurate results with all classes of fuels, and when once fitted up with all the necessary accessories tests can be made with it in from one-half to one hour. The whole of the apparatus should be dismantled and cleaned after each test, especial attention being given to the bomb cylinder and cover, as the gold plating of these requires very careful cleaning and drying if it is to last any length of time. Portion of the thin platinum wire used for ignition is generally fused and burnt during the combustion, but the heat produced by this is included in the value of x used for the water equivalent of the apparatus.

When testing anthracite or coke the platinum wire ignition sometimes fails to ignite the charge, and to overcome this difficulty ten grammes of a standard bituminous fuel may be used on top of the weighed portion of coke or anthracite as ignition charge. The thermal value of this addition must be allowed for in calculating the results of the test.

A Letter from Manchuria.

The following excerpts from a private letter recently received in this city, from Manchuria, may prove of interest:

I am ever so much obliged to you for the ELECTRICAL REVIEW which I just received. I am greatly pleased to see that notwithstanding that nearly ten years have passed, you still remember our friendship. Many things have happened during the above-mentioned time. I will give you a short description of all.

When I returned from my trip with Patrick Alexander in 1897, I joined the telegraph again. In 1890 I was engaged as interpreter for the erection of the Lake Baikal ice-breaker, which was brought in pieces or sections to Listreincehnia on Lake Baikal and erected by Englishmen, whose interpreter I was. After she was finished, I was given a billet of third mate of the big boat called the "Baikal." In 1901 in the summer, I was engaged again as interpreter to a gold-mining Russian company which had a concession in Mongolia. The mines were to be worked with hydraulic power, the same as in California, and all the principal people were Americans from California; the chief manager was from the American side, James Dietrick, of San Francisco. The mines failed—certainly on account of everlasting frost, which a hydraulic can not take. We had also a dredger, which was a total failure; so I came to the conclusion that what you can do in America you can not do here.

After stopping at the mines two years, I had to leave on acount of their bankruptcy. In the summer of 1903, I returned to Irkutsk with 1,000 rubles in my pocket. My family, mind you, was wandering all the time with me. I could not find a job to suit me in Irkutsk, but I met a friend one day who told me that the Eastern Chinese Railway Company was engaging telegraph operators, so I applied for a billet, and received it. I arrived to headquarters of the company at Harbin with all the little Grants, in October, 1903. I was on my arrival ordered to Port Arthur, where I went; and it was in my presence, dear old friend, the first shot was fired at us. The war had opened, so I as quick as possible sent my family away, but I could not go; it was against my principles. The day after the war broke out I was made the superintendent of the central telegraph office, Eastern Chinese Railway Company, on account of the running away through fright of the chief, whose place I took.

I held out the whole of the siege, and stood to the last. I showed some bravery during the siege, for which I received a St. George's cross, of which I am proud; it is not for the sake of wearing the regalia, but for my son, who will very soon take his father's place, and that is a good example for a young man—to let him be like his father and be true to his country when he is needed.

The siege was awful: it is impossible to describe it on paper or by words—something awful at first, but a man gets used to it; it's nothing after a time; a man changes into something unexplainable; he loses fright, his nerves get ironized—if it's possible to express yourself that way; you have no pity for anything, and somehow or other you do not feel frightened to die.

After the capitulation, December 19, 1904, I was interpreter for the Russian committee for the handing over the railway to the Japs. I left Port Arthur, January 10, 1905, *via* Pigeon Bay, with all my telegraph clerks, whom I managed to pass as non-combatants. We went on Chinese junks to Chefoo, from there to Shanghai, and then to Odessa, where I arrived on March 13, 1905. . . . I am at present serving for the Eastern Chinese Railway Company, as English teacher. I am teaching English to telegraph clerks, which is necessary now to everybody. I have lots of private lessons, and I make now from 700 to 800 rubles per month—making money "hand over fist." It is a craze here now to learn English. .

Could you be kind enough to send me some catalogues and prices of electrical supplies: messenger boxes, in fact a whole plant—relays, registers, boxes, batteries and diagrams for the district stations, for putting up a district messenger telegraph office—the latest messenger boxes, please.

A. GRANT.

Harbin, Manchuria, July 1.

Electric Operation of the Teltow Canal.

Description of the System in Use on an Important German Waterway.

By Frank C. Perkins.

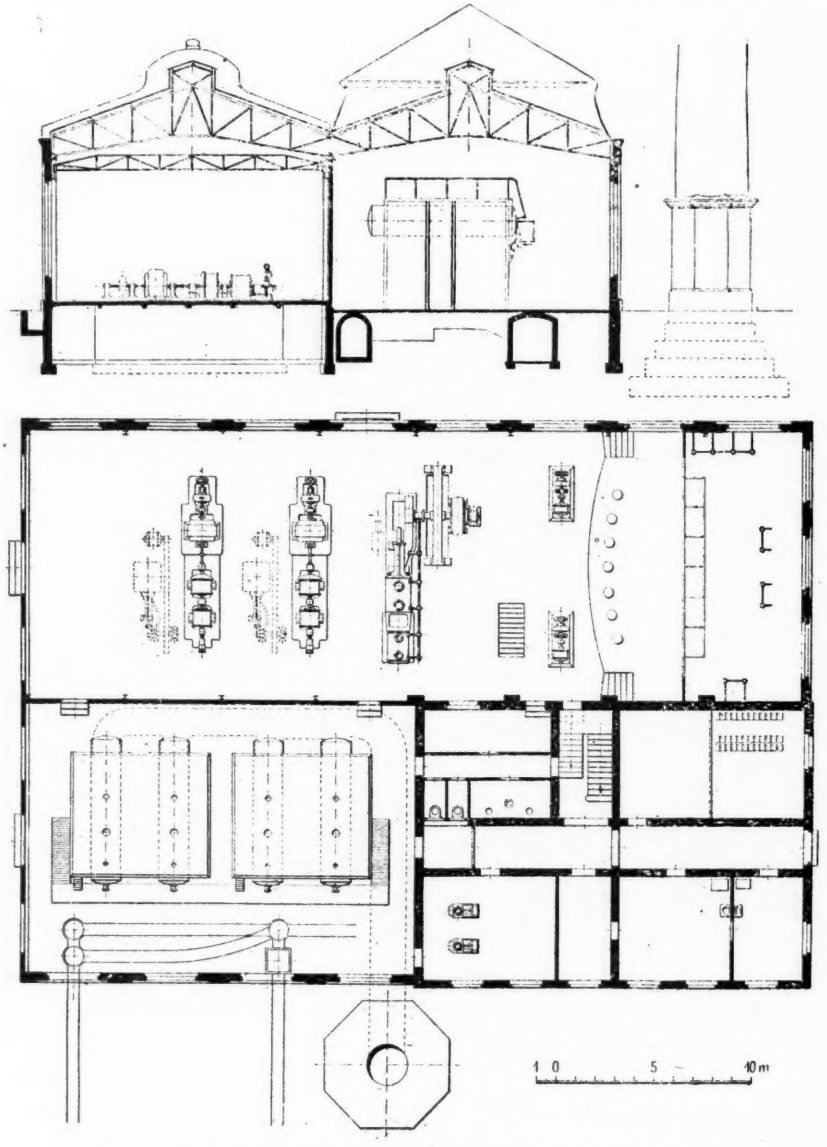
ELECTRIC canal towage in Germany has recently been demonstrated as commercially successful on the Teltow canal near Berlin, and the application of electricity to inland waterways has been shown to be most desirable.

The Teltow canal is 23.5 miles long and connects the river Spree with the Havel at Glienicker Lake. At the river Spree about nine miles from Berlin, near Drunau, the canal starts with a width of sixty-eight feet and a depth sufficient for canal boats drawing nearly six feet of water and having 1,200,000 pounds register. The boats usually employed on this canal are 110 feet long and 8.6 feet wide. The canal has a depth of eight feet at low water in the middle and seven feet at the sides.

Between Havel and the Spree there is a difference of level of about ninety-seven feet and a system of locks has been installed about five miles from the Havel, consisting of two locks placed side by side with a wide masonry wall between them. A system of conduits has been provided within this wall for filling and emptying the locks with a minimum amount of water, the arrangement being such that the water used by a boat going down the canal may be emptied into the other lock for raising the boat going in the opposite direction. During the low-water season water is pumped from the lower to the higher level by means of a centrifugal pump electrically operated, having a capacity of one cubic metre a second and electric hoisting gates are used at the locks. Each of these four electric hoist gates is operated by a fifteen-horse-power motor, running at a speed of 600 revolutions per minute. These electric motors as well as the power station for supplying the necessary current were installed by the Siemens-Schuckert Company, of Berlin. The motors are of the three-phase induction type, operating at a pressure of 200 volts. The gates may be raised to their full height of 8.27 meters in one minute by means of electric power. Electromagnetic brakes are provided and the gates are counterbalanced with variable weights, the electric motors being employed for both hoisting and lowering.

During high water it is necessary to conduct a portion of the water from high to low level and this is done by means of a gate in the middle wall operated by an eight-horse-power induction motor. This alternating-current motor is also operated from the power station at a speed of 580 revolutions a minute.

The accompanying illustration shows the interior of the power station of the Teltow canal which is equipped with a 300-horse-power reciprocating engine installed at that end of the station nearest the switchboard, together with two steam turbines of the Zoelly design, constructed by Escher, Wyss & Company, of Zurich, Switzerland. Each of these turbine units consists of two steam turbines, a high-pressure and a low-pressure turbine, provided with five runner discs, and developing a total of 1,000 horse-power. There is thus a total capacity of 2,300 horse-power, two 1,000-horse-power turbines and one 300-horse-power reciprocating engine. Space has been provided for other units to be added as additional power is required. The reciprocating engine is coupled to a large revolving-field alternator, and a multipolar direct-current dynamo on the same shaft.



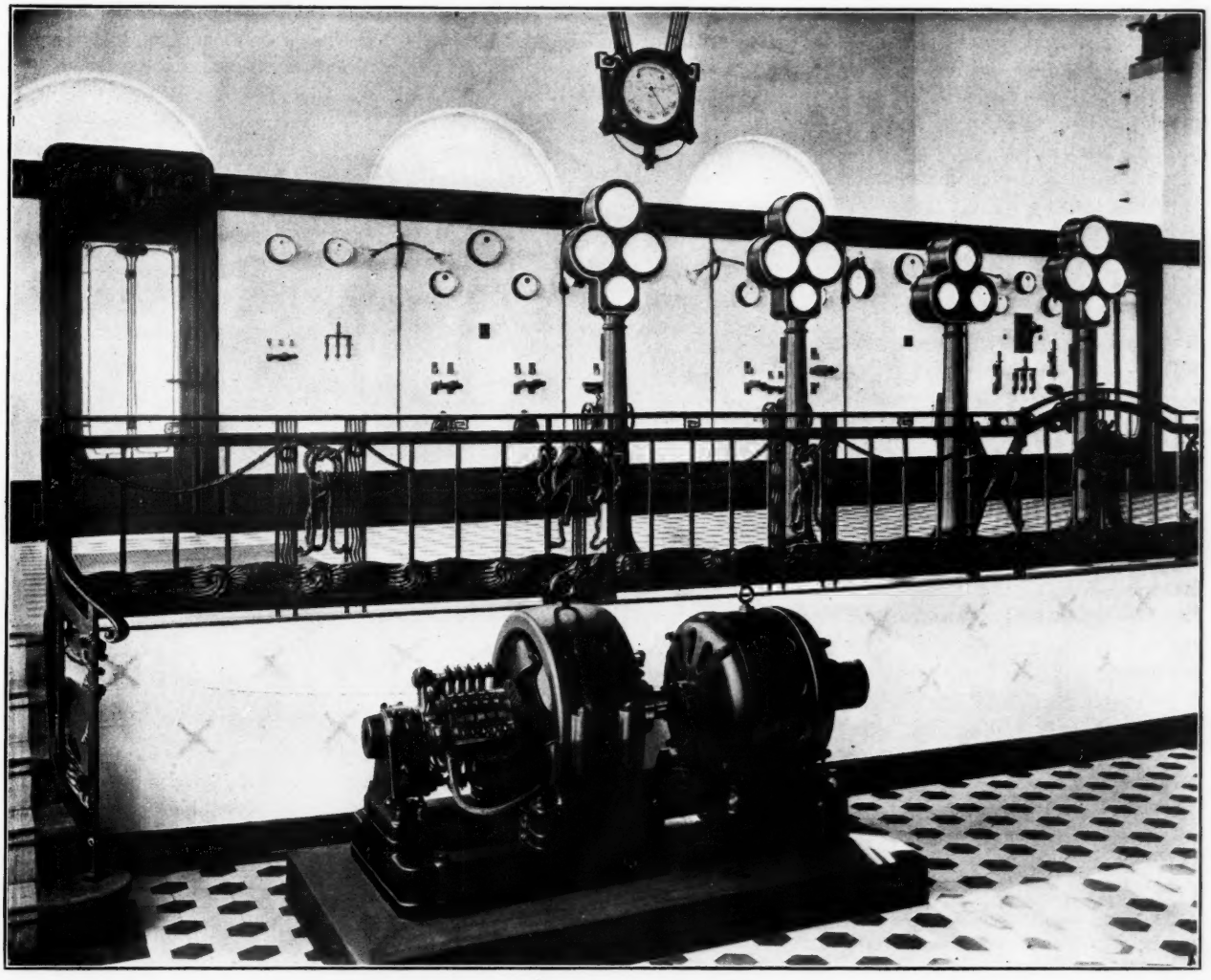
PLAN AND ELEVATION OF CENTRAL POWER STATION, TELTOW CANAL.

Each of the 1,000-horse-power steam turbines is directly coupled to a three-

phase alternator of the revolving-field type, supplying a current of 6,000 volts and a frequency of fifty cycles per second. On the same shaft is mounted a Siemens-Schuckert compound-wound direct-current dynamo of the inner-pole type, supplying a continuous current at a pressure of 600 volts. The alternators driven by the steam turbines have a rating of 650 kilowatts, and 230 kilowatts is the output of the alternator direct-connected to the reciprocating steam engine. The direct-current machine driven by this engine is rated at 110 kilowatts, while the two continuous-current dynamos operated by the steam turbine are of 200 kilowatts each.

In connection with the steam turbine, jet condensers are employed and three-phase motors are utilized for driving the pumps. A vacuum of ninety-five per cent is maintained, as there is plenty of condensing water. Steam is supplied to the high-pressure turbine at a pressure of 180 pounds per square inch, superheating being provided to 300 degrees centigrade. There are four water-tube boilers, each of which is provided with a superheater which can be utilized or not as desired, the latter having a heating surface of sixty-five square feet, supplying 8,000 pounds of superheated steam per hour. Each of the boilers has a heating surface of 2,200 square feet, and supplies steam to the turbines at the rate of 13.4 pounds of steam per horse-power-hour, this being the consumption of the 1,000-horse-power turbine at full load. At half-load the steam consumption is increased to 15.6 pounds. At three-quarters load the consumption is 14.3 pounds.

At the end of the Teltow power station, near the switchboard, are located the exciter units which consist of three-phase alternating-current motors of the induction type direct-coupled to shunt-wound direct-current dynamos rated at thirty-two kilowatts, supplying the exciting current at sixty-five volts. The three-phase induction motor of each exciter set is supplied with an alternating current of 220 volts and drives the generator at a speed of 960 revolutions per minute. A storage battery has also been provided for lighting the station and exciting the alternator fields when desired or in case of emergency. This accumulator plant consists of thirty-six storage belts, each having a capacity of 126 amperes for a period of half an hour, which is sufficient for lighting as well as exciting the two large alternators for that length of time.



Switchboard and Exciter Sets at Teltow Canal Central Power Station.

At the East end of the canal a substation has been provided which is equipped with two rotary converters, having a capacity of 150 kilowatts each, and operating at a speed of 1,000 revolutions a minute. Space is also provided for a third unit when desired.

In the Teltow central station there is an overhead traveling crane of sixteen and one-half tons' capacity.

For the operation of a locomotive towing the canal barges, for the trolley line and for the towing carriages at the locks,

continuous current is utilized, while for all auxiliary work, as well as for lighting purposes, the three-phase alternating current is utilized.

Various types of engines, motors and hauling methods have been tried on this canal. Alcohol engines as well as gas engines have been utilized on the boats, also steam engines with oil-fired boilers and electric overhead trolleys with two collecting poles have been tried for conveying current to electric motors in experimental boats.

A sixty-horse-power Daimler alcohol motor was placed in one of the boats and was found to take .01 kilogramme of alcohol per ton-kilometre (0.035 pound per ton-mile). This would result in a cost per ton-kilometre of one-twentieth of a cent with alcohol costing five cents per kilogramme (.08 cent per ton-mile).

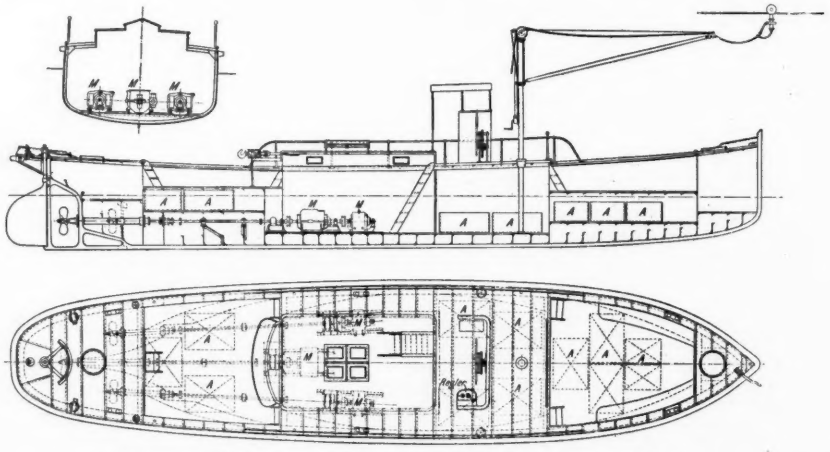
With the oil-fired boilers and the steam engine the cost of operation when towing two boats with a load of 2,400,000 pounds at a speed of two and a half miles per hour would be .01 cent per ton-kilometre (.016 cent per ton-mile), with oil costing less than a cent per kilogramme. The steam oil-fired boiler tug was found to take 1.1 pounds of fuel oil per horse-power-hour, the boat taking 100 horse-power at the speed above mentioned.

An electric tug was also tried and at the same speed, two and a half miles per hour, the boat was found to have an efficiency of twenty-two per cent, the energy consumption being nine kilowatt-hours per ton-kilometre (14.5 kilowatt-hours per ton-mile). The efficiency was found to be low, and therefore the cost of operation so high that the electric power tug was given up. This experimental boat with motor-driven trolley, called the Teltow, was of the triple-screw type and was provided with a storage battery of 220 cells, having an output in five hours' discharge of 244 ampere-hours. The battery was located in three of the six compartments of this boat, with a total weight of 26,000 pounds.

Each of the three propellers was provided with a series direct-current motor connected to the shafts by flexible coupling. The three motors were placed in one compartment. The motor driving the centre shaft had a capacity of twenty-five horse-power and ran at a speed of from 300 to 500 revolutions a minute, while the two motors driving the side propellers developed twenty horse-power each.

For collecting the current to supply the motors of the electric tug, double trolley poles were tried, but were not very successful, and the Lombard-Gerin motor-driven trolley was also used, which gave better success, although it was noted that the trolley-collecting motor would tend to lag behind when the boat was operating at full speed under light load, while it would travel in advance of the tug when several heavy canal-boats were being pulled. As before mentioned, the cost of operation caused the electric-power tug-canal haulage to be given up in favor of a locomotive towing the boats from the side of the canal on a specially constructed track.

The Siemens & Halske canal locomotive haulage was designed to operate on a track of one-meter gauge, hauling two loaded canal-boats of 600 tons each at a speed of 2.5 miles per hour. This locomotive was found to require an energy consumption, at the above speed, of 5.5 kilowatt-hours per ton-mile, while with a speed of 3.1 miles per hour, the energy consumed was found to be 8.5 kilowatt-hours per ton-mile. It is stated that the mean efficiency of the locomotive was sixty-five per cent.



Plan and Elevation of Electrical Towboat, Teltow Canal.

This electric canal-haulage locomotive was provided with a four-wheel truck, equipped with two eight-horse-power electric motors of the series direct-current type, and a trailing pair of wheels supporting the rear end of the locomotive with the guide arm and drum for the tow line. The hauling motors were connected by two sets of gears to the axles, operating at a speed of 800 revolutions a minute; these series motors were driven from a 500-volt overhead trolley line. The guide-arm for the tow line is manipulated by a three-horse-power motor connected with a screw to the arm through a pair of bevel gears. This motor operates at a speed of 1,460 revolutions per minute, and is also used for driving the drum which winds up the towing rope consisting of a ten-millimeter wire line. The coupling of the drum is of the friction type, so arranged that when a pull of 2,500 pounds is exceeded, slipping will occur. Therefore when starting a heavy load the locomotive will take its load gradually, as the 400-pound pull required in starting a 600-ton boat will cause the drum to slip until it is partially under way.

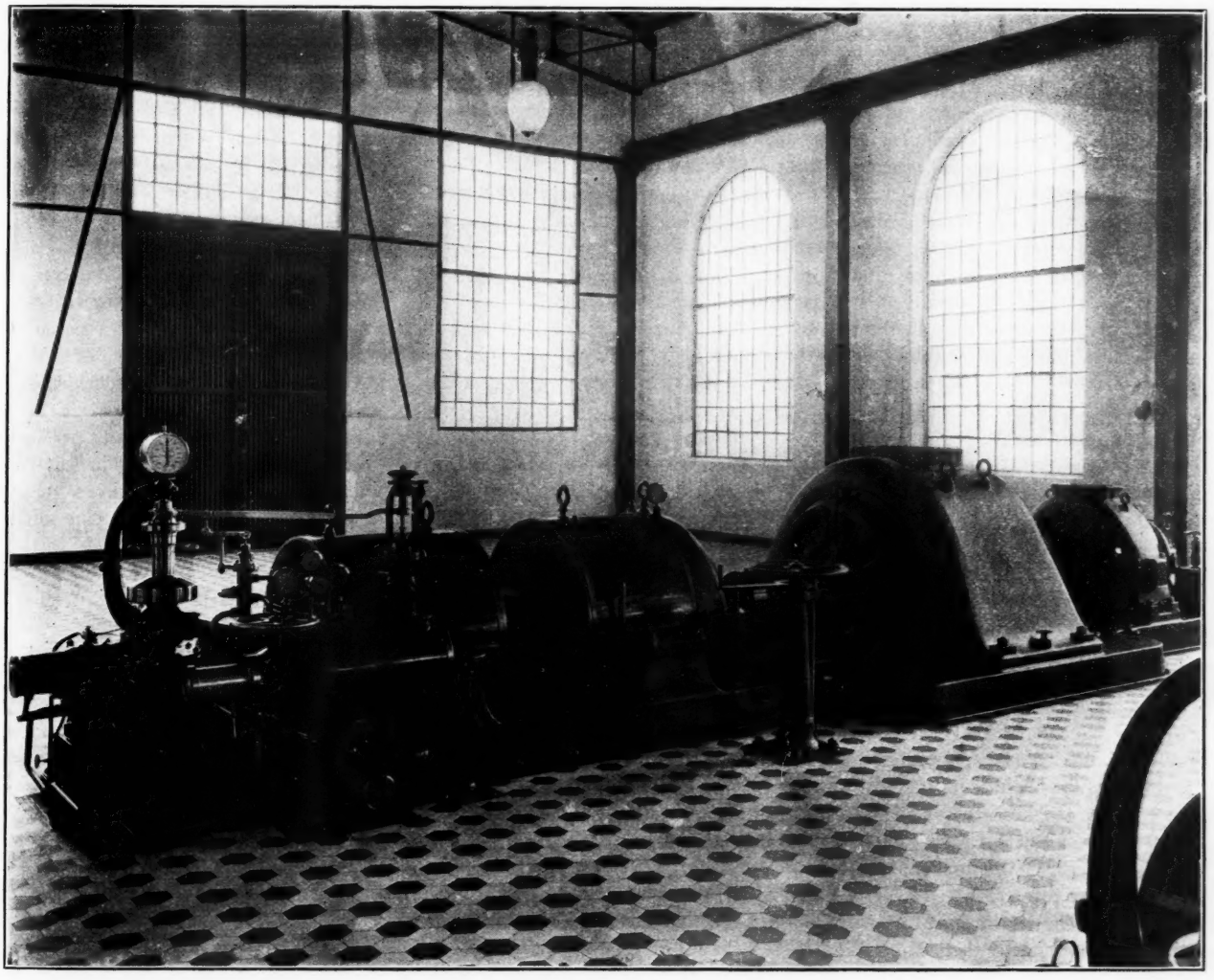
The locomotive weighs 16.5 tons. The greater part of the weight is carried by the wheels on the side toward the land, this being 4,200 pounds for each of the driving wheels and 1,200 kilogrammes for the trailing wheel. On the side toward the canal, the weight on the trailing wheel is 850 pounds and on each driving wheel, 3,000 pounds.

The arrangement of the weight of all the auxiliaries on the side of the locomotive away from the canal as well as the placing of the driving motors, as far as possible, on that side is on account of the tendency to tip the locomotive by the pull on the tow line. In order to overcome this to a still greater degree the rail on the side nearest the canal is raised somewhat higher than the inland rail.

For handling the boats at the locks special provision has to be made and a trestle construction was built, extending 455 feet along the middle of the canal, provided with two parallel tracks. For hauling the boats into and out of the locks electrically operated crane-cars were provided on these tracks, each weighing 3,300 pounds. The current used on these crane-cars is from the direct-current system of 600 volts, continuous-current motors are utilized operating at a speed of a trifle over 1,000 revolutions a minute. The trucks are geared to the track by means of two sets of gears. Each motor develops from ten to twelve horse-power,

which is sufficient to haul a boat in one-half hour from a point about 350 meters from one end of the lock to a similar distance at the other end. The two locks can be operated at the same time, with two boats in each lock, giving a tonnage of from 60,000 to 70,000 in twenty-four hours, or about 35,000 tons in twelve hours.

According to a recent report of the United States consul at Brussels, a laboratory museum of electricity in that town will be opened to the public next month. The museum has been built and equipped by R. Goldschmidt, of Brussels, whose object in presenting the museum is the development and extension of the use and application of electricity in Belgium by practical experimental instruction. The institution will contain all kinds of electrical models and appliances, which may be freely handled for study and experiment. Models and apparatus will be conveniently placed at the disposal of the public upon separate tables, and may be connected with the electric supply at will.



TELTOW CANAL STEAM TURBINE, CENTRAL POWER STATION.

COLOR PHENOMENA IN PHOTOMETRY.[1]

BY J. S. DOW, B.SC.

The discussion of Dr. Fleming's paper on Photometry, read before the Institution of Electrical Engineers in 1903, revealed great differences of opinion on the importance of color phenomena in photometry, and it still does not seem to be generally known to what extent they are noticeable under ordinary working conditions. This may be due to the fact that most of the work done on this subject was carried out with special apparatus, such as the spectro-photometer, and not with the ordinary implements of photometry.

It therefore occurred to the author that some simple experiments on these points, carried out by him at the Central Technical College on an ordinary photometrical bench, might be of interest.

[1] Paper read before the Physical Society, of London, May 25, 1906. *Phil. Mag.*, August, 1906.

The sources of light were two similar glow lamps, which could be screened with glass of different colors, and which were compared by means of one or other of several different photometers in the usual way. Four photometers were made use of during the experiments—the Lummer-Brodhun, the grease-spot, the Joly, and the flicker.

The uncertainties which may be introduced by color phenomena appear to be due to four separate effects:

1. The difficulty experienced in forming a judgment in the case of differently colored lights, and the possibility that the judgments of different people may not be the same.

2. The fact that the apparent relative brightness of two surfaces, illuminated by light of different color, depends on the part of the retina on which the image of them is received.

3. The Purkinje phenomena.

4. The possibility, when mirrors are

made use of, that the coefficient of reflexion may not be the same for different colored lights.

1. No doubt people differ in their capacity in this respect, but according to the author's experience it is chiefly a matter of practice. After a considerable amount of practice, he has found that it is possible to secure fairly consistent results even when comparing such colors as ruby-red and signal-green, while any one unused to such work would be quite unable to do so. Extraordinarily consistent results were sometimes obtained, but it was found that if the observer stopped work for an hour or so, his readings afterwards would settle down to another very consistent value, but differing by, perhaps, five or even ten per cent or so from those obtained before. This seems to suggest that extreme consistency in reading is partly a matter of visual memory. We recall the impression previously received by the eye and involuntarily set the photometer, the next time, so as to produce the same appearance of the field of view.

The difference in sensibility of different eyes to a particular color certainly introduces another disturbing factor in observations made by different people. The author has not met with any serious differences in judging the color contrasts which ordinarily occur, but it might be supposed that, in such an extreme case as that quoted above, considerable divergences in judgment would exist, and have, indeed, been recorded by Sir William Abney, Professor Rood and others.

It must be noted, however, that the effect mentioned in 2 must be eliminated, in order to make any satisfactory comparisons. All the figures given in this paper were obtained by the author himself, though corroborative results from other eyes were obtained in many cases.

2. This effect has been very completely dealt with by Sir William Abney in his investigation on color vision.

It has long been known that the central portion of the retina—"the yellow spot"—is much more sensitive to the red end, and less sensitive to the blue end of the spectrum, than the surrounding portion of the retina.

It has been suggested that the "yellow spot," being yellow in color, will obstruct the blue rays, but will allow the yellow rays to pass through practically unimpeded to the light-perceiving organs. This explanation, however, does not explain why the differences observed are distinctly more noticeable at low illuminations.

There appears to be another physiological effect, which will be referred to later.

Suppose, now, that we compare a red and a green light with a Joly photometer. An image of the illuminated blocks is formed on the retina, and we adjust the position of the photometer until the red and green appear equally bright.

But if we now observe the photometer obliquely, or if we observe it with the eye at a different distance away, the image falls on a different part of the retina where the sensibility to red and green may be different. Consequently the red and green may no longer appear equally bright.

And if a photometer with blocks of a different size were used we might again come to a different conclusion; for, even if the eye were kept at the same distance, the size of the image would be different, and a new portion of the retina would be covered by it.

The position of the photometer, for

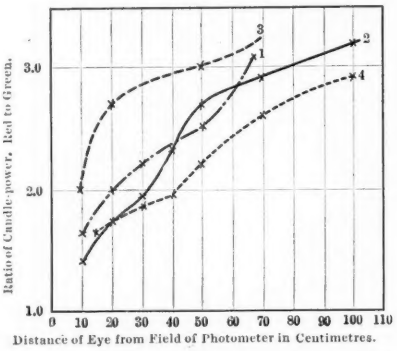


FIG. 1.—RUBY-RED LIGHT COMPARED WITH SIGNAL-GREEN.

(1) Lummer-Brodhun Photometer (telescope removed.) (2) Joly Photometer. (3) Joly Photometer (linear dimensions of blocks reduced one-half.) (4) Grease-spot Photometer.

which we obtain balance, therefore, depends upon—

(*a*) The obliquity at which rays from the illuminated surface strike the eye.

(*b*) The distance away of the eye from the surface.

(*c*) The size of the surfaces.

The first point is not very important, for in focussing our eyes on the surfaces we involuntarily look straight at them. But (*b*) and (*c*) may easily affect the readings considerably. This is brought out in the curves in Fig. 1.

These curves were obtained as follows: Two glow lamps, screened with red and green glass respectively, were run at a constant P.D., and compared by means of each of the three photometers referred to above.

In each case a series of readings was obtained with the eye at different distances away from the illuminated surfaces. It should be mentioned that in the case of the Lummer-Brodhun photometer, the telescope was removed while the readings were taken. As will appear later, however, considerable variation is possible even with the telescope in position, as in use.

Curves 1, 2 and 3 speak for themselves. They bring out two points. Firstly, that the ratio of the candle-powers of the red and green lights, as thus observed, is quite different for each photometer. Secondly, that this ratio depends on the distance of the eye from the photometer, the red becoming more and more accentuated as the eye recedes. Also the red is most accentuated and the curve is steepest for the Lummer-Brodhun photometer, in which the field is smallest.

Curve 4 was obtained by placing in front of the blocks of the Joly photometer a paper screen which reduced its linear dimensions by one-half. The reduction in size of the blocks corresponds with a still further accentuation of the red.

This effect has been found to be quite distinctly observable in several commonly occurring comparisons. Fig. 2 exhibits the connection between the apparent relative candle-power and the distance away of the eye with a Joly photometer, when a Nernst lamp was compared with a glow lamp (running at 3.7 watts per candle-power), and when an incandescent mantle was compared with a Methven burner.

In the Joly photometer the distance away of the eye is left entirely to the inclination of the observer, and it will be seen from the above that differences of five per cent or more might easily be introduced between the readings of different observers in this way.

In the Lummer-Brodhun photometer the distance of the eye is limited, to some extent, by the use of the telescope. But the position of the telescope can be varied between wide limits without putting the field out of focus, and this latitude allows of a considerable difference in the readings.

In the table below the extreme differences are given for these two limiting positions of the telescope:

Nature of Lights Compared.	Ratio of Candle-Power.		Percentage Difference.
	Telescope In.	Telescope Out.	
Ruby-red to signal-green.....	1.65	2.20	25.0
Glow lamp (3.7 watts per candle-power) to Nernst lamp....	1.38	1 43	3.5
Methven gas standard to incandescent mantle.....	0.129	0.135	4.4
Harcourt ten candle-power Pentane standard to Fleming standard lamp.	0.652	0.657	0.77

Here, again, a distinct difference in

reading is produced in several practical cases.

It is also remarkable that a small but distinct effect was produced in the last case, even though the flame of the Harcourt lamp is only very slightly redder to the eye than the light from the Fleming glow lamp.

It is difficult, of course, to speak with certainty of such a small change as this—a change which would be produced by moving a photometer, set midway between two lights two metres apart, a distance of less than two millimetres. But the writer has usually found that the mean of a set of readings, taken with the telescope out, worked out to a value slightly different from the mean of those taken with the telescope in, and the difference was always in favor of the redder of the two lights. It need hardly be said that the difference observed might be important in such work as these two standards are used for.

There is one other point that requires mention. It is, of course, often necessary to reverse a photometer in order to correct for any differences between the

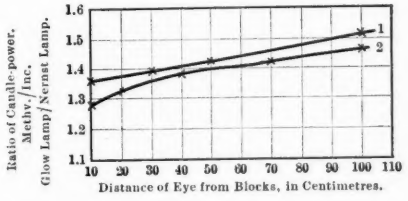


FIG. 2.—CURVES FOR JOLY PHOTOMETER.

(1) Glow lamp compared with Nernst lamp. (2) Methven gas standard compared with incandescent mantle.

two sides of the screen, etc. However, for lights, of similar color, very little difference is produced by doing so, as a rule.

But when the lights differ in color the Lummer-Brodhun behaves differently from the Joly and grease-spot photometers. In the case of the latter, the image the retina receives is unaltered by reversing. But, with the Lummer-Brodhun, the image is reversed. If, before reversing, we see a green disc with a red centre, after reversing we see a red disc with a green centre.

We should, therefore, expect a much greater difference on reversing the photometer in the case of the Lummer-Brodhun.

The following figures, obtained for similarly colored lights, and for red and green lights, exhibit this:

Photometers Used.	Lights of Similar Color.			Red to Green Light.		
	Ratio of C. P.		Per Cent Difference.	Ratio of C. P.		Per Cent Difference.
	1st Pos.	2d Pos.		1st Pos.	2d Pos.	
Joly.....	0.93	0.91	2	2.24	2.12	5.5
Grease-spot....	0.94	0.91	3	1.81	1.70	6.0
Lummer-Brodhun.	0.95	0.91	4	2.10	1.75	18.0

3. The Purkinje phenomenon has often been referred to as the chief source of trouble in heterochromatic photometry, but it appears to be only troublesome at very low illuminations.

An experiment was shown illustrating the Purkinje effect. A series of colored screens, diminishing in size from about four feet square, as shown in the diagram (Fig. 3), were illuminated by a thirty-two candle-power glow lamp at a distance of about ten feet away. All these screens were made from the same identical red and blue paper, but, even at normal illuminations, it could be seen that as the surfaces became smaller the red appeared brighter and brighter in comparison with the blue. The red, however, was distinctly the brighter, even in the case of the very large screen.

The illumination was now weakened by introducing resistance in series with the glow lamp, and the blue began to appear brighter. A point was soon reached when, for the very large screen, the blue was unquestionably brighter than the red. At this stage the difference in appearance of the different-sized screens was much more marked than at the higher illumination; and, in the case of the smaller screens, the red was still much brighter than the blue.

As the light was still further weakened the colors began to disappear until, eventually, the red appeared as black, while the blue shone out with a phosphorescent white appearance. After this point the blue also fades away until nothing can be seen.

There is, however, a distinct difference between the behavior of the very big screen and the very small ones. In the case of the latter the Purkinje effect is much weaker. Both colors seem to fade away together, and, by the time the Purkinje effect is really noticeable on the big screen, the very small screen can scarcely be seen at all.

In fact, to see the Purkinje effect really well, it is necessary to stand quite close up even to the big field.

A very interesting physiological explanation of these effects has been given by M. Sartori in a recent paper.[1]

Dotted about over the retina are two varieties of light-perceiving organs, known from their appearance as the "rods" and the "cones" respectively. The rods, it is thought, are sensitive to light but can not perceive color. Light of any color appears to them white, but they are most sensitive to blue light. They are, moreover, sensitive to very weak light; but as the illumination is increased they become, as it were, saturated, and do not respond any further. The cones, on the other hand, perceive color, but are most sensitive to yellow-green light, and while they do not respond at the low illuminations at which the rods can act, they continue to respond further to increased stimulus, once they have started, long after the rods have ceased to do so.

At normal illuminations, therefore, it is the cones which chiefly act, and we see

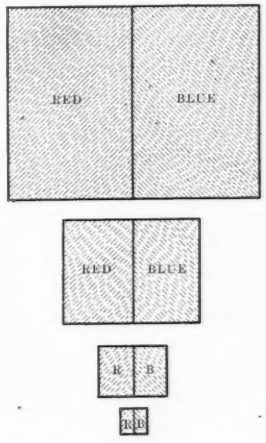


FIG. 3.—SERIES OF COLORED SCREENS ILLUSTRATING PURKINJE EFFECT.

color. At very low illuminations the action of the rods is predominant, and we can not see color, while light of a bluish color shines out with a whitish appearance. As the illumination is increased the cones suddenly begin to act and the colors appear. Then takes place what has been called "The Battle of the Rods and Cones." It is while this battle is in progress that the Purkinje effect is noticeable.

But the Purkinje effect is complicated by the fact that the rods and cones are unequally distributed over the retina. At the yellow spot the cones are predominant. Consequently, the Purkinje effect is much weaker when the field of view subtends a small angle at the eye.

This uneven distribution of the rods and cones will also explain the fact, referred to above, that at low illuminations the size

[1] *Electrotechnik und Maschinenbau*, March 18, 1906.

of the field of view can produce much greater differences in the results.

In order to gain an idea at what illumination the effect becomes noticeable in practice, the following experiment was carried out:

Two 100-volt eight-candle-power glow lamps were run in series with a constant P.D. of 190 volts across them.

One was screened with red glass and the other with green glass. The distance between the two lamps was varied from twenty inches to 250 inches, and the mean of a set of readings, giving their relative candle-power, taken in each case. In order to avoid the effect mentioned in 2 above, the Lummer-Brodhun photometer was used, and the telescope was kept in exactly the same position throughout the experiment.

Fig. 4 shows the result of plotting the ratio of the candle-power of the two lamps against the illumination of the photometer disc, in candle-metres.

From what has been said above, it is clear that we can not strictly define the candle-power of a red light in terms of white-light standard, because this ratio depends upon the distance of the eye from illuminated surfaces.

Nevertheless, in order to give an idea of the order of illumination used, the red lamp was compared against a two-candle-power Methven gas standard, using the Lummer-Brodhun photometer, and its candle-power worked out to something of the order of 0.25 candle-power.

The relative illuminations used in the curve are expressed in terms of this figure.

It will be seen it is only when the illumination has been reduced to about 0.2 candle metre that the ratio of the red to the green light begins to decrease.

The same experiment was tried on several occasions with lights of different candle-power, and it was always found that fairly consistent results were obtained until the illumination fell to something of the order specified above, when the accentuation of the green light began to appear.

At such illuminations it is very difficult to obtain readings at all, and the mean of a great many should be taken. The eye seems to be in a state of uncertainty, and one receives the impression that the lights are continually varying. In fact the eye seems to be in a state analogous with that of unsaturated iron on the steep part of the magnetization curve.

It may safely be assumed, therefore, that in all ordinary cases, where the illumination would be at least ten or twelve times as great as that employed above, where the field of view would subtend a comparatively small angle at the eye, and where we should never meet with such an extreme color contrast as in this case, the Purkinje phenomena will not materially influence the results.

4. In order to obtain the curve of vertical distribution of light from arc lamps, etc., the beam of light is often reflected in the desired direction by means of a forty-five degree mirror.[1] When this is done, the question arises, whether the coefficient of reflection of the mirror will be the same for lights of different color.

The following experiment was carried out with a silvered glass mirror of this type: Two 220-volt thirty-two candle-power lamps were run in parallel off a constant P.D. of 200 volts. The two lamps were compared against each other direct. They were then compared when the light from one of them was reflected along the bench from the mirror. In this way, the coefficient of reflection of the mirror is easily obtained.

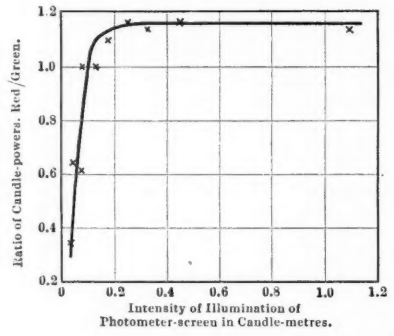


FIG. 4.—CURVE, EXHIBITING PURKINJE PHENOMENA FOR RUBY-RED AND SIGNAL GREEN LIGHTS.

This was repeated when the lamps were screened with red and green glass, successively.

The mean of one set of determinations gave—

Coefficient of reflection, 78.8 per cent for unscreened lamps; 79.0 per cent for red light; 77.8 per cent for green light.

Repetitions of the experiment gave slightly differing results, but it was found that the values for the three different colors did not differ among themselves by more than 2.5 per cent. Moreover, no connection could be traced between these differences and the colors for the difference was sometimes in favor of the red light and sometimes in favor of the green.

We may safely conclude, therefore, that in all ordinary cases, where the difference in color is less pronounced than that adopted here, the effect is inappreciable.

In any case, the adoption of adjustable photometers of the Simmance-Abady type will probably render mirrors unnecessary in obtaining curves of distribution of light in the future.

The only really important effect, under ordinary working conditions, therefore, is that described under the second heading. It has been shown that this may, apparently, give rise to a perceptible discrepancy even when lights so similar in color as the Harcourt ten-candle Pentane standard and the Fleming glow lamp standard are compared.

FLICKER PHOTOMETERS.

The interesting question now arises whether photometers of the Flicker type are also influenced by these color phenomena.

If, as is claimed, the disappearance indicates that the two surfaces appear equally illuminated to the eye, one would suppose that all the conditions which determine this impresson must also determine the point of disappearance of the flicker. On the other hand T. C. Porter and others have come to the conclusion that the flicker, at ordinary illuminations, is independent of color.

Through the kindness of Messrs. Everett, Edgcumbe & Company the author has been able to make some experiments on the points referred to with a photometer of this kind.

It is clear, in the first place, that when comparing lights of different color, the readings of an ordinary photometer and a flicker photometer may not agree even if the latter be independent of all color effects. For instance, when two lamps giving light of exactly the same color were compared, the results with the Joly photometer and the flicker photometer were exactly the same. The two lamps were now screened with red and green glass respectively, and the ratio of the red to the green, obtained by the flicker photometer, was about 1.34; but with the Joly photometer it was found possible to get readings from 0.7 to 1.4 for distances of the eye up to one-half metre. Agreement between the photometers occurred when the eye was about 40 centimetres away from the blocks of the Joly.

One difficulty met with in this investigation was as follows: As the effects observed were comparatively small, it was advisable to use lights widely differing in color. On the other hand the position of minimum flicker, though sufficiently sharply defined in most practical cases, is far from being so when such colors as red and green are observed. In such cases, the method followed was to note the position of the photometer in which a flicker

[1] A mirror, that is, which rotates about an axis making an angle of forty-five degrees with its plane.

was just visible on either side of balance, and take the mean. There is, however, another method of judging the position of balance for these two colors.

When the photometer is too near the red light, the field of view in the photometer appears reddish in tint. Similarly, a greenish tinge shows that the green illumination is the stronger. When the illumination of the two surfaces, illuminated by light of these two complementary colors, is the same, an intermediate grayish tinge is produced. To the writer's eye the transition from red to gray to green was sharper than the disappearance of the flicker, and a series of tests showed that the result was the same in each case. The method, however, is only applicable to complementary colors.

Some experiments were first made to discover whether a difference of reading could be produced by altering the telescope, as in the case of the Lummer-Brodhun photometer, but no distinct difference was observable. Next the telescope was removed, and readings were taken with the eye about twenty centimetres from the aperture. A brass tube was then inserted which allowed the aperture to be inspected from a distance of 60 centimetres from the eye. It was then observed that, as the eye was withdrawn, the field became distinctly redder, and readings taken by the "disappearance of flicker" method also showed a change of relative candle-power in favor of the red. The following table exhibits some of the results obtained:

Nature of Lights Compared.	Eye 20 Cm. from Aperture.	Eye 60 Cm. from Aperture.	Percentage Change.
Ruby-red to signal green.	$\frac{\text{Red}}{\text{Green}} = 1.52$	$\frac{\text{Red}}{\text{Green}} = 1.70$	12
Ruby-red to light from unscreened glow lamp (white).	$\frac{\text{Red}}{\text{White}} = 0.70$	$\frac{\text{Red}}{\text{White}} = 0.75$	6
Methven gas standard to incandescent mantle.	$\frac{\text{Methv.}}{\text{Inc.}} = 0.28$	$\frac{\text{Methv.}}{\text{Inc.}} = 0.29$	3

The effect is very noticeable when observed in the following way: Supposing we are comparing red and green, and have placed the photometer so as to secure balance. Move the photometer until a distinct flicker can just be seen owing to the green being too bright. It will be found that as the eye is removed the flicker gradually disappears. But if the photometer is put out of balance on the red side, the flicker does not disappear but becomes if anything more distinct as the eye is removed.

It appears therefore that this flicker photometer is affected by the distance of the eye, but, apparently, not to a sufficient extent to be noticeable when the telescope is used, as in ordinary work.

It is difficult to see why these effects should be so much less noticeable than with ordinary photometers. It almost seems as though, when two differently colored objects are placed side by side, any change in their relative illumination becomes exaggerated, thus creating a different impression to that received when they are viewed alternately (as in a flicker photometer).

An attempt was also made to discover whether the flicker photometer was subject to the Purkinje phenomenon. Now it is well known that the speed required to just make the flicker disappear depends upon the illumination, and the writer has found it impossible to judge the point of disappearance of the flicker with any certainty at the extremely weak illuminations necessary to produce the Purkinje effect.

The plan of "color-reading" referred to above was therefore adopted. It may be objected that in doing so the real question at issue is avoided altogether. But the method, while admittedly not so satisfactory as the "disappearance of flicker" method from this point of view, has been shown to give the same results at ordinary illuminations, and to the writer it seems impossible that the green illumination could be brighter and yet the field of view appear red.

Two 100-volt eight-candle-power lamps screened with red and green glass in the usual manner were used for the experiments. They were first run at 100 volts, and compared against each other at different distances. The two lamps were then run off fifty volts only, so as to produce a very low illumination, and the experiment repeated. The following table shows very clearly the influence of the Purkinje effect.

Lamps Run at 100 Volts.		Lamps Run at 50 Volts.	
Distance Between Lamps.	Ratio $\frac{\text{Red}}{\text{Green}}$	Distance Between Lamps.	Ratio $\frac{\text{Red}}{\text{Green}}$
50 inches	2.32	40 inches	2.0
60 "	2.26	50 "	1.5
70 "	2.25	60 "	1.1
130 "	2.15	70 "	0.7
150 "	2.25	90 "	0.6

At the higher illumination the readings differed among themselves considerably (as was only to be expected with such a great color contrast), but they do not seem to be connected in any way with the illumination.

The readings at the low illumination can only be regarded as very approximate, but they bring out very clearly the accentuation of the green as the illumination gets weaker.

The conclusion the writer draws from these experiments is that flicker photometers are affected by the same color phenomena which affect ordinary photometers.

The interesting assertion was made by Messrs. Simmance and Abady, in a paper before the Physical Society,[1] that a color-blind person obtained practically the same results with their flicker photometer as people with normal sight. On the other hand, Sir William Abney, speaking of color-blindness, remarks:[2]

"We can not hope, for instance, that the red-blind, who sees no red in the extreme end of the spectrum, would show any luminosity in that region. . . . One of the most striking experiments in color-vision is to place a bright red patch on the screen and to ask a red-blind to make a match in luminosity with the white. The latter will have to be reduced to almost darkness—a darkness, indeed, that makes the match almost incredible."

It seems incredible that such a person, when comparing red and green with a flicker photometer, would obtain the same results as if he had normal sight. However, it appears that, according to Dr. Edridge Green,[3] color-blindness is of two kinds. A person may be unable to distinguish, say, red light by color, but nevertheless a red object may appear as *luminous* to him as to any one else. On the other hand, the color-blindness may be due to the fact that the eye is incapable of perceiving red light at all. A color-blind person of the first variety would presumably make normal photometrical readings. A person of the second class must, surely, obtain abnormal readings with all photometers, flicker or otherwise.

This is borne out by some of Professor O. N. Rood's experiments on flicker.[4] He found that those of his students who were color-blind obtained abnormal results with his flicker photometer. Indeed, he actually used the flicker photometer to investigate not only cases of color-blindness, but also the difference in sensibility to light of different colors of the eyes of persons with normal sight.

In conclusion, the writer wishes to express his great indebtedness to Professor Ayrton, and also to J. M. McEwan, for their assistance and for many valuable suggestions.

[1] *Phil. Mag.*, vii., p. 341 (1904).

[2] "Color-Vision," p. 83.

[3] "The Physical Aspects of a Theory of Color-Vision," by F. W. Edridge Green, M.D., British Association, 1902.

[4] *American Journal of Science*, 1899, p. 258.

Length of Wave and Speed of Propagation of Electrical Phenomena.

By definition the wave-length of a vibration is equal to the product of the period of vibration by the speed of propagation. The same definition ought to be applicable to electrical discharges through matter, in which the distance is that between adjacent ions. Examining this view, G. Rosset holds that it should be possible to check it by the known wave-length of visible discharges. When a luminous discharge is obtained—for example, in the violet—the wave-length of the light given off is about 0.0004 millimetre. From data obtained in measuring the sparking distance in gases it has been found that the number of ions present is about 16×10^{12} under atmospheric pressure, and that a rarefaction of about eighty-seven per cent must be obtained in order to secure violet light. This would bring the distance separating ions remarkably close to that called for by the preceding observation. Examining next the speed of propagation of electrical phenomena it is shown that this is directly proportional to the square root of the specific inductive capacity of the dielectric medium and to the one-sixth power of the concentration of the ions. Applying these figures to the speed of propagation of an electrical effect in iron and in copper, good agreement is secured, for it has been found experimentally that the speed in iron is about 62,000 miles per second, and in copper about 112,000; while the specific resistivity of the two metals indicates corresponding concentrations of the ions, the ratio being 1.84 to one. Considering the expression for speed of propagation, it is shown that it varies inversely as square root of the constant of attraction in Coulomb's law. Now, from Maxwell's theory, the speed of light is proportional to this same figure, so that the speed of propagation of electrical phenomena is greater for a given concentration of ions or electrons the poorer the dielectric medium is as a transmitter of light. This is strikingly illustrated by the relation between the opacity and conductivity of the vitreous and crystallized states of selenium.

Copper prices keep climbing and the market objective seems to be twenty cents. There has been a great eagerness to secure supplies, and more inquiries have come to producers than can possibly be entertained. It is estimated that this country alone is using copper at the rate of 720,000,000 pounds per year.—*Copper Gossip.*

THE RELATION OF THE ALTERNATING-CURRENT MOTOR TO CENTRAL-STATION POWER BUSINESS.

BY E. W. LLOYD.[1]

The bearing that the development of the alternating-current motor has on the securing of power business is greater than generally supposed.

It is not the intention to treat this subject in any but a general way, the object of this paper being merely to call to your attention the necessity of the cooperation of central-station men with the manufacturers, encouraging them in the design of apparatus that will meet the requirements of customers applying for central-station service.

We all run across cases where business was lost because we could not secure motors that would do the work as satisfactorily as the direct-current motor, the margin between the cost of the operation of a private plant and central-station service being so small that in order to secure the best results from machinery, the manufacturer often decides to install his own plant and direct-current motors with a resulting loss to the central-station company.

If we can secure motors that will do the work asked for by the customer, we will help our own cause materially.

With the increase in the capacity of central stations and the tendency towards the generation of alternating current at high potential in large units, it has become possible to furnish power in large quantities at a low price to the consumer several miles from these central stations.

If this power can be furnished directly from our overhead or underground lines with the use of transformers instead of installing substations, even for large quantities of power, the saving to the central-station companies will be material. Some companies are to-day installing substations on customers' premises, furnishing them power, and standing the loss in transformation as well as the investment involved.

The past few years have seen a large increase in the use of alternating-current motors in connection with factory work. This has been largely due to the decreased cost of these motors, the prices now approximating closely prices of direct-current motors of the same size and speeds.

Excepting on tools and machinery requiring variable speeds, the alternating-current motor is generally admitted to be a better prime mover than the direct-current motor, owing to its overload characteristics.

This motor having been developed to a point where it can be guaranteed as a perfectly reliable prime mover as far as ordinary work is concerned, we are only waiting for the development for variable speed work for factory use.

There have been numerous developments on single and multi-phase motors for variable speed work by different manufacturers, one company having on the market single-phase motors up to three horse-power that will do variable speed work with very fair results.

While, as with the three-phase motor, the operation of this type of motor is not as successful as the direct-current motor, still it is a great step in advance and of the utmost importance to central-station companies.

Already the possibility of equipping cranes and hoists with alternating-current motors has been realized. In Chicago we have several manufacturers using current from the three-phase, 220-volt, sixty-cycle system who have their factory equipped with traveling cranes using three-phase motors. These equipments, while not perfect, are reliable enough so that the parties using them are very well satisfied. In fact one large customer, having approximately 700 horse-power in motors, is changing over a number of traveling cranes from direct-current to alternating-current motors. This is being done in order to save the loss in the changing of the current from alternating to direct current through rotary converters. One large alternating-current crane is already in operation, and is proving entirely satisfactory.

We have also equipped several jib cranes with alternating-current motors with satisfaction, being able to handle molten metal in five-ton ladles with perfect safety.

One large foundry has several ladles running on tracks equipped with variable speed alternating-current motors, enabling the operator to tip the same at will, and as easily as if equipped with direct-current motors.

For small printing-press work we have arranged to install three-phase variable speed motors on cylinder presses, and while we know it is not possible to get the wide range of speed or efficiency possible with the direct-current motor, still the installation is a vast improvement over the

[1] Read before the Association of Edison Illuminating Companies, Frontenac, Thousand Islands, N. Y., September 4, 5 and 6, 1906.

old installation or belt drive and cone pulley.

The possibility of equipping alternating-current motors with automatic starting devices is bound to be realized. With this device it is possible to start and stop a motor driving an air compressor from the varying pressure in the storage tank. One company has a starter ready for the market which it will guarantee.

With alternating-current motors doing the work described above, the troubles of obtaining power business in larger quantities are to some extent overcome, as one of the most difficult obstacles in the way of obtaining this business was the fact that the alternating-current motor was not capable of giving anywhere near the duty to be obtained of the direct-current motor.

The alternating-current motor has many advantages: its ability to operate under overloads, which would destroy a direct-current motor; it can operate in dirty places without extraordinary attention; its freedom from sparking; and last, but not least, the low cost of maintenance.

The direct-current motor has been specialized in many ways and designs, and in small sizes is made to accomplish results economically by the removal of many of the friction losses present in shops where shaft driving was used.

The manufacturers of alternating-current apparatus have not as yet made these motors to meet conditions required in individual driving, such as that used in connection with stereotype machinery, printing machinery, bookbinding machinery, or any of the small tools now generally equipped with individual motors, but there is no reason that this can not be done.

Alternating-current motors equipped with back-gears would find a ready market to-day, as the demand for individual drive on all classes of machinery in factories is more pronounced every day.

As near as I can ascertain, there has not been the demand on the manufacturers for variable speeds in these motors that there might have been; the manufacturers being left to do the experimenting, if not leisurely, still not as fast possibly as if the demand had been greater and more urgent.

Certain manufacturers of apparatus have refused, not later than a year ago, to manufacture traveling cranes equipped with alternating-current motors, and if it had not been pointed out to them in a forcible manner that their competitors would get the business, they would still be in the same frame of mind.

If our central-station power business is to increase in outlying districts and we are to take care of this business with the same advantages to the customer as in the districts where we furnish direct current, we must have a prime mover that will fit all cases.

In our efforts to obtain power business in the alternating-current districts, we find that it is essential that we be able to recommend to our customers elevators that will operate satisfactorily on the alternating-current system without undue disturbance to the pressure on these lines.

There has been a large amount of money and a great deal of thought put into the development of a direct-connected, alternating-current electric elevator, but I believe it safe to say that the progress made in the last two years has been greater than in the previous ten, and that the next two years will see even greater advances along these lines.

We can now see alternating-current, multi-phase motors in connection with elevator service giving excellent results, as the manufacturers are ready to place on the market machines of this type that have been perfected to such a point that their operation is quite satisfactory, the manufacturers stating that the machine takes about double full-load current in starting.

While, as true of other alternating-current motors for regular duty, they are not as good as are direct-current motors as yet, still these elevators are very excellent indeed, considering the many difficulties that were necessary to be overcome in connection with their design and manufacture.

We all know that when the direct-connected, direct-current elevator was connected to our lines years ago, many of the companies had serious trouble with their pressure on these lines.

The demand for the alternating-current elevator is growing rapidly, and in direct proportion to this demand the design is becoming better.

It is possible to-day to obtain an alternating-current, direct-connected, multi-phase elevator that is practically noiseless in its operation so far as the motors, brakes and controller are concerned, and as these three sources of noise have been the objectionable feature in alternating-current elevators in the past, we can safely say that an elevator of this type can be secured that is practically noiseless.

I had the pleasure of examining a machine of this type in operation, and it was as free of noise as is necessary, running practically the same as a direct-current, drum-type machine. This machine is equipped with magnet control, the main magnets operating directly from the alternating-current circuits. Driven from the worm shaft by a Renolds silent chain is a small direct-current dynamo, which is used to furnish current to the acceleration magnets on the controller.

Machines of the larger sizes are equipped with this direct-current dynamo, while machines of smaller sizes for apartment-house work can be operated with alternating-current magnet controller without the use of direct current, and the elevator companies are prepared to take orders for this class of machine at this writing.

The manufacturers have had in operation for nine months an alternating-current motor with alternating magnet control in their shops. They claim that the machine has not had any further adjustment than that which would be required by an ordinary direct-current controller. This machine was also automatically operated by push buttons.

While I did not have the pleasure of seeing this controller in operation, I will say that the alternating-current magnets operated in conjunction with the elevator which was equipped with a small dynamo operating the acceleration magnets did not make a particle of noise. The elevator is question had a speed of 210 feet a minute. The elevator company promised speeds up to 300 feet a minute for 1,500-pound lifts.

These elevators are equipped with alternating-current magnet brakes in the same general way as the direct-current elevators. The brake on the worm shaft seemed to work perfectly.

In addition to the electric brake, this car was equipped with a device preventing accident to the elevator should there be any phase changes on the line. This device would prevent the operation of the car until the trouble was rectified.

The push-button type of elevator has not, I believe, received the support from central-station companies that it should. This type of elevator is in an excellent state of development, and there is no doubt a wide field for its use in apartment buildings in outlying districts.

This push-button elevator has been perfected in connection with an alternating-current, multi-phase motor to such an extent that it can be operated very satisfactorily, at least good enough for all ordinary purposes.

The hoisting part of the apparatus runs

very smoothly, and the controlling part of the mechanism is very fine indeed, it being practically impossible to have an accident on this type of machine through any thoughtlessness on the part of the person operating it.

Outside of New York, I am not aware that there are any automatic elevators to speak of, even in the largest cities in this country, while in Europe I am told they are quite common.

Taking it altogether, the situation as regards the electric elevator is very flattering indeed. The progress being made is very good and promises to continue.

The experiments being conducted in connection with all types of electric elevators cover a large field, and a great deal of money is being spent and many able men are constantly designing new devices for the perfection of this class of elevator.

The progress in the design of single-phase motors in connection with direct-connected elevators has not been as satisfactory as with the multi-phase motor.

We have one single-phase, direct-connected elevator on our lines in Chicago which was installed to replace an old 500-volt machine. The old apparatus was used; the motor and controller only being changed. The operation of this elevator, while giving fairly good results to the apartment building, is hardly satisfactory to us, as the starting current is about five times the full-load current. When the line is well loaded the effect is not appreciable, but during times when the line is lightly loaded the effect on the lighting system is very noticeable.

The motor in getting up to speed makes considerable noise, and even when running at normal speed is more noisy than desirable. The company making it claim they will in a short time be able to place on the market a machine that will act more satisfactorily, but there is room for a considerable improvement before this outfit will approach the smoothness of operation of the multi-phase machine above mentioned.

We hope to see many improvements in the design of alternating-current apparatus, and, as stated in the first part of this paper, we should cooperate in encouraging the manufacturers in making apparatus that will suit all conditions of service.

Unless we are prepared to make considerable reductions in the price of current we must get this class of business by removing every possible waste, increasing the output of each machine and improving the operation of them by the application of devices that can be operated electrically and automatically.

While investigating the progress made in the manufacture of alternating-current elevators, the improvements in the electric traction elevator were brought to my notice, and I thought a word at this time, while somewhat outside of the scope of this paper, might not be amiss regarding high-speed electric elevators for office buildings.

To-day in the larger cities the use of electric elevators has increased to a very large extent, so that owners and builders of high buildings seriously consider, and very often favorably, the installation of electric elevators instead of hydraulic. Not only the first cost is less, but the electric elevator has been perfected to such an extent that the smoothness of operation compares favorably with all types of hydraulic elevators, not only for local but for express service either in dry-goods stores or office buildings.

The traction elevator has practically solved the high speed, high lift, electric elevator problem, and while there will no doubt be many improvements in electric elevators in the future, still this type of elevator is bound to have a great influence in favor of central-station service in office buildings and stores in our large cities, owing to smoothness of running and economy of operation.

The traction elevator can be placed either on the roof of a building or in the basement, whichever is the most desirable and economical, taking up little space in either location.

The main objection to the traction elevator to-day is that it is not quite as economical in the consumption of current as the drum type of elevator, owing to the very low motor speed and correspondingly large size of the motor.

The present motor for this type of elevator has a speed of from sixty to 100 revolutions per minute.

To make a commercial piece of apparatus of this speed, the efficiency of the motor is sacrificed to some extent. Necessarily the size of a motor of this speed is larger than of the standard commercial motor, and the shop and material costs are greater.

Experiments are at present being made with high-speed motors for traction elevator work, and the prospects of obtaining satisfactory results look very bright. If this feat is accomplished it will further reduce the initial and operating cost of the traction elevator.

The drum type of machine has been improved greatly in the past few years. The magnet control has had a wonderful influence on the smooth running of machines of this type.

The electric brake has also been improved, and this type of brake is not only now applied to the worm shaft, but is also applied internally to the drum itself in such a way that it greatly increases the smoothness of the operation of this type of elevator in stopping, thus permitting the operation of drum types of elevators at high speed, and according to the manufacturers up to 400 feet a minute.

More strenuous missionary work among architects and owners of buildings about to be erected, with information of the proper sort in regard to electric elevators, would go a long way towards increasing the popularity of this type of machine.

The elevator companies are in this position: they are able to build any type of machine, and it makes little difference to them whether or not the customer uses central-station service. It is up to the electric light companies to take hold of the situation in a methodical manner, obtaining accurate information regarding the cost of operaton of different types of elevators. There have been many figures submitted regarding these costs, but I believe the subject will stand closer investigation.

With the advance in the design and manufacture of electric elevators, placing this machine on a high plane, it seems to me that enough evidence could be secured so that we would not be afraid to present the true costs of operation to our customers with great advantage to ourselves.

The Montreal Light, Heat and Power Company's Soulanges Canal Power Station.

The Montreal Light, Heat and Power Company has recently contracted with the Canadian Westinghouse Company, Limited, for a large addition to their power equipment. The apparatus contracted for is for the new Soulanges Canal power station on the St. Lawrence river. The equipment consists of three 3,750-kilowatt revolving-field alternating-current, two-bearing generators connected to water turbines. These generators are 7,200 alternations, 4,000 volts, three-phase, operating at 225 revolutions per minute. There are also two 150-kilowatt direct-current, 125-volt exciter units. Thirteen 2,500-kilowatt oil-insulated, water-cooled transformers are an important part of the equipment. Seven of these transformers will be used for raising the voltage at their generating station from 4,000 to 44,000 volts, and six of them will be used at the lowering end of the transmission line, stepping down the voltage from 44,000 to 12,000.

The generators and exciters will be controlled by motor-operated rheostats and the complete switchboard apparatus, which the Canadian Westinghouse Company is furnishing for both the main and substations, will involve the latest type of electrical control, representing the highest development of switchboard apparatus.

Convention of the Illinois Electrical Association.

The annual meeting of the Illinois Electrical Association was held at Springfield, Ill., September 19 and 20. The sessions were convened at the Leland Hotel, and over 100 superintendents and managers of electric light plants were in attendance. A number of exhibits of electrical apparatus were also made.

Mayor Deveraux welcomed the visitors to Springfield. After the preliminary work a paper entitled "System of Accounting for a Moderate-Sized Plant," was read by W. J. Achepohl, of Galesburg. Following the discussion of this paper the remainder of the morning was taken up by W. G. Austin, of Effingham, who presented a paper entitled "Gas Engines." This subject was also thoroughly discussed.

In the afternoon a paper by J. Robert Crouse, entitled "Profitable Commercial Cooperation," was presented. Mr. Crouse was unable to be present, and the paper was read by one of his associates. A paper entitled "Electrical Meters" was read by Robert C. Lanphier, of Springfield.

Following the reading of papers in the afternoon the members of the association boarded special cars and visited the plant of the Sangamo Electric Company. The watch factory at Springfield was also visited, and the power-station of the Public Utilities Company inspected. Luncheon was served at Washington Park Casino, and in the evening the guests were entertained at a theatre party.

The association concluded its convention on the afternoon of September 20. The following programme was presented for the day: reports of insurance committee and other committees; general talk on points of interest in connection with station operating, discussion to be opened by Charles Sharp, of Moline; paper by F. W. Willcox, Harrison, N. J., entitled "Present Status of the Incandescent Lamp."

In the afternoon the executive committee went into executive session and the following officers were elected:

President—J. N. C. Shumway, Taylorville.

First vice-president—E. L. Brown, Elmwood.

Second vice-president—E. McDonald, Lincoln.

Third vice-president—E. H. Gray, El Paso.

Fourth vice-president—O. L. Hyatt, Chicago.

Secretary—H. E. Chubbuck, La Salle.

Treasurer—J. J. Frey, Hillsboro.

Executive committee—Emil G. Schmidt, Springfield; Charles Sharp, Moline; W. M. McKinley, Champaign; Frank J. Baker, Chicago; David Davis, Litchfield. The executive committee was authorized to select the place of the next meeting and to make all arrangements.

After the business session in the afternoon the members of the association were the guests of the Illinois Traction System, and a trip was made over the company's line, inspecting the power plant at Riverton.

The Opening of the Camden-Atlantic City Line of the West Jersey & Seashore Railroad.

The new West Jersey & Seashore Railroad which has been electrified between Camden and Atlantic City, N. J., by the Pennsylvania Railroad, was opened for passenger traffic on Tuesday, September 18. A full schedule of trains has been arranged, express trains leaving Camden and Atlantic City every hour on the hour, from 7 A. M. to 11 P. M. daily, making the run in ninety minutes.

In the construction of its high-speed electric line from Camden to Atlantic City, the West Jersey & Seashore Railroad Company has taken care to cover the third rail wherever the road comes into or crosses public property; as well as at other places where it is accessible to the public.

The greater part of the sixty-five miles of double-track road runs through property owned by the West Jersey & Seashore. On both sides, the tracks are separated from the abutting property by stout fences.

Wherever the tracks cross a public street or road, the side fences turn in toward the track and across the tracks themselves, and meeting the fence is a "cattle guard."

The third rail never continues across a public highway, but stops five feet back of the property line. The current is carried under the highway by connecting wires. With contact shoes on all cars a train is able to maintain continual connection with the third rail at the crossings.

Unusual precautions have been taken to protect the third rail at stations. In front of the stations and for a considerable distance beyond in both directions it is covered over the top by a board, and directly opposite the platforms there is an additional covering on the side. The "shoe" attached to the car goes under the top covering to make contact with the charged rail.

The third rail is protected on station sidings, for the sake of employés, just as it is in front of platforms. Along the "team tracks," too, where freight is loaded and unloaded, the same measures have been taken.

The third rail gives way to overhead trolley wherever the electric road parallels public streets, as in Camden, the western terminus, Vineland, and Millville. When the current comes from the trolley the contact shoes are not charged at all, as there is a switch in the car to disconnect them when the third rail ends.

In Atlantic City, from the terminus to the point where the tracks go upon the elevated structure, the third rail is protected all the way. Even up on the "filling," the approach to the elevated structure, with high embankments on both sides, the wooden coverings are installed. The crossings at Ohio avenue, Indiana avenue, Illinois avenue, Kentucky avenue and the rest are just as they would be if trolley wires furnished the current.

Meeting of the Colorado Electric Light, Power and Railway Association.

The annual meeting of the Colorado Electric Light, Power and Railway Association was held at Denver, Col., September 20. The programme included the reading of papers entitled "Voltage Regulation," by Leonard Wilson; "The Use of Polyphase Motors in Outlying Districts," by W. A. Carter; "Profitable Commercial Cooperation," by J. Robert Crouse; "The Lighting of Small Stores," by J. R. Cravath; "Watertight Lightning Arresters," by A. M. Ballou; "Transformer Testing and Line Records for Transformers," by E. P. Dillon, and "Steam Turbines," by C. C. Chapple.

The members of the convention visited the power-house of the Denver City Tramway Company as guests of the company, and also inspected the high-tension substations of this company. The supply houses furnished a theatre party and other forms of entertainment, and a trip was made to the foot-hills of the Rocky Mountains.

The secretary's report showed the association to be in a flourishing condition, with a largely increased membership. The convention was well attended.

Officers were elected as follows:

President, George B. Tripp.

Vice-president, W. C. Matthews.

Secretary and treasurer, J. F. Dostal, Denver, Col.

Additional members of the executive committee: F. W. Frueauff, J. E. Beeler.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

What Degree of Accuracy Is Feasible and Necessary in Wiring Calculations?

Certain inconsistencies in wiring calculations are pointed out by Albert Scheible, who questions why they should exist and suggests more consistent practice. Wiring tables give the size of wire to an average exactness of 0.01 per cent, and he has found it the practice to use these figures to the last place, although the wire itself may vary one per cent in size and methods of computing length allow for a variation of two per cent. Another practice in the use of the resistance constant differs also, some using a constant as low as 10.35, and others eleven. Other figures met are 10.5, 10.8 and 10.6. Certain authors adopt a constant not stating any conditions of temperature and purity of copper. Others use a rather large constant; for instance in dynamo design, and thus allow for a longer wire than that computed, not giving any reason why the wire should always be longer, and not shorter, than the calculated length. To avoid these discrepancies it is suggested that certain approximate dimensions, accurate to one-half per cent, be used, and the same method be done with respect to the resistance of these sizes of wire.—*Abstracted from the Journal of the Western Society of Engineers (Chicago), August.*

A Thermochemical Electric Generator.

When sulphur dioxide water and bromine are brought together sulphuric acid and hydrobromic acid are formed, with a liberation of energy. Under proper conditions this may appear as electrical energy, developing 0.63 volt per couple. The mixture of acids may then be heated and decomposed into the original constituents and used over again in the cell. This method of generating electricity has been patented in France by L. P. Basset. The cell consists of a hermetically sealed vessel divided into a number of compartments by means of porous partitions, each compartment being again divided by a carbon wall. Sulphurous acid is circulated through half of these chambers, bromine water being passed through the alternate ones. The apparatus thus forms a series of electrolytic cells, the carbon-plates being the electrodes. To make the process continuous, the sulphurous acid and the bromine solutions are passed through the cell from reservoirs. After leaving the cell, the mixture is carried to a vaporizer, where the application of heat brings about the decomposition of the two acids. The sulphur dioxide passes off as a vapor, bromine passing away with the water of decomposition, the two chemicals being then ready to be returned to their respective reservoirs.—*Translated and abstracted from La Revue Électrique (Paris), July 30.*

Coils of Bare Aluminum Wire.

The suggestion is made here that advantage be taken of the fact that aluminum rapidly becomes covered with an oxide which is a fair insulator. This makes possible the winding of coils of bare aluminum wire, the oxide providing sufficient insulation between adjacent turns. This may be done without any special precaution being taken when the pressure between adjacent layers is not greater than one-half volt. In general, it is considerably less than this. For coils exposed to higher potentials, the completely wound coil may be submerged in a chemical bath which produces an oxidation resulting in a coating of insulation sufficiently strong to resist 100 volts; but, in general, it is not necessary to have resource to this method, since the moisture contained in the air is usually sufficient. For large coils, where there may be large differences of potential, a hydroscopic material may be interposed between adjacent layers. Paper is excellent for this, and it is well to wet it as each layer is placed on. It then rapidly produces an insulating coating. If the coil be intended for alternating currents it is well to pass a direct current through it for about fifteen minutes, thus heating it to about 100 to 120 degrees centigrade. After such preparation the paper may be completely carbonized without producing a short circuit. In general, coils wound in this way give the same properties for the same dimensions as when insulated copper wire is employed, for the saving due to the absence of insulation will more than make up for the lower conductivity and therefore the larger cross-section of the aluminum wire. For larger coils it may be advisable to employ square wire. Coils have been prepared in this way and have been submitted to various treatments without any breakdown in the insulation appearing. A table is submitted showing the dimensions of various coils wound with insulated copper and bare aluminum wire. The aluminum coil of the same dimensions and resistance is considerably lighter, yet contains about the same number of turns. A similar comparison is made between the field coils of a 1,500-kilowatt generator. The coils have the same interior and exterior diameter and length. The same number of turns is obtained on each winding with approximately the same length of wire. The resistance is also the same, but the weight of the aluminum coils is less than half that of the copper and the cost about seventy-five per cent as much.—*Translated and abstracted from L'Industrie Électrique (Paris), August 25.*

Planning the Construction of a Power Plant.

The location of the power plant and, in particular, the relation of this with respect to the water supply, fuel supply, storage and handling is considered at some length by A. E. Dixon. One important feature frequently overlooked is the available labor supply. The attractions which the neighborhood presents have a great deal to do with making the men contented with the locality. Where possible it is desirable to select a site which will attract men with families, and who can therefore be depended upon. With regard to water supply considerable latitude is allowable, owing to the possibility of piping from a distance. It is advisable to provide city connections when available in case of emergencies. An insufficient supply of water should be supplemented by a cooling plant. Considering the fuel the cost should be reckoned as that at which the fuel is delivered to the boilers, including in this the cost of disposing of the ash. It is more important to be close to a supply of fuel than to the ash dump. For large plants fuel storage has become absolutely necessary, and various systems which have been

adopted are described somewhat in detail. It has been found by Playfair and Meyer that the fuel value of stored coal may decrease about thirty-five per cent in a few years. It is well to provide steam at the storage yard for thawing out the coal-handling apparatus as well as the coal in the cars during the winter. Spontaneous combustion not infrequently takes place in such storage yards, often going on for months before it is detected. When such fires occur generally the only method of extinguishing them is to move the coal. Various methods of handling coal and delivering it to the boilers are described. It is held that when conveyers are used the runs should be horizontal and vertical, and not inclined. Friction is frequently very large in these devices.—*Abstracted from the Engineering Magazine (New York), September.*

The Voltage Regulation of a Continuous-Current Dynamo.

Many methods have been proposed for predetermining the regulation of alternators. In this article H. M. Hobart develops a similar method for predicting the regulation of continuous-current dynamos. The method consists in analyzing the effects which enter into the problem and deducing formulæ for their resulting effect. The armature reaction at any time depends upon the brush position, and is usually expressed in ampere turns per pole piece. It is usually divided into two parts, the demagnetizing and the distorting components. The former is found to be proportional to the brush lead expressed in commutator segments, to the current, and to the number of armature turns per segment; and inversely proportional to the number of conducting paths through the armature from positive to negative brushes. The influence of the distorting ampere turns is proportional to the number of commutator segments per pole, less those included in the double angle of lead, to the current flowing, and to the number of armature turns per segment; and inversely to the number of paths through the armature from positive to negative brushes. These deductions are expressed as equations which may be applied to any machine if the data of the machine be given. The application to a 500-kilowatt dynamo is shown, the predetermined characteristics being compared with those found experimentally. The agreement is fairly satisfactory.—*Abstracted from the Electrical Review (London), August 24.*

A Korean Hydroelectric Transmission Plant.

The Maraposa Commercial and Mining Company has operated, with considerable success, electric plants in connection with its California mines, and its experiences there led to the adoption of the same method for certain mines in Korea in which the members of the company are interested. William M. Dean, who superintended the installation of the hydraulic and electric equipment, describes here the character of the plant and the difficulties under which it was built. The mines are situated about forty miles from the Yalu river, and had been operated by steam, the fuel being wood. The scarcity of this led to the adoption of water power. Much difficulty was encountered in securing satisfactory poles. Any wood obtainable was used, and the bases of the poles were charred, other methods of preserving not being available. The transmission line is five miles long. The holes were dug by Korean labor, and the poles were erected by Chinamen. The iron work was done by Japanese. The equipment consists of a turbine operating under a 110-foot head, direct-connected to a 500-kilowatt, 13,000-volt, rotating field, three-phase alternator. The pipe-line is 325 feet long. Much of this equipment reached the site considerably the worse for wear, the transformers and other electrical apparatus being soaked with water and covered with ice. The plant was put into operation in October of last year, and has already effected a considerable saving in the cost of developing the mines. The conditions for operating a water-power electric plant in Korea are similar to those in northern California, except for the difficulty of getting competent operators.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), September 8.*

The Iron Arc.

In this communication Professor W. G. Cady described some interesting work which has been done at his laboratory with the iron arc. While experimenting with the electric arc between iron electrodes, H. D. Arnold found that there was a certain critical potential difference at which an abrupt change took place in the conditions of the arc. Subsequent investigation has shown that the effect is closely analogous to the hissing point of the carbon arc. If the iron arc be started with a large external resistance and maintained at such a length that the current is well below one ampere, it burns with little or no sound, and its appearance in the neighborhood of the anode is very diffuse and ill-defined. As the external resistance is gradually decreased, the potential difference falls and the current rises, until a certain critical value, depending upon the length of the arc and the size of the electrodes, is reached. At this point a very small decrease in external resistance suffices to cause a sudden increase in current and drop in potential difference, precisely as with the carbon arc. At the same time, the arc contracts, a bright spot appears on the anode, and a characteristic hissing sound begins. A further increase in the current is accompanied by a continued decrease in potential difference. The hissing stage begins at a different potential difference from that in the case of the carbon arc. If the experiment be carried out in the reverse order, starting with a large current, the discontinuity is encountered again, but not until the current has been diminished beyond the value that it had at the beginning of the hissing stage. With the arcs of six millimetres in length and more the current on the hissing stage can, with care, be decreased until it is smaller than the previous largest value on the quiet stage. Thus there are two possible values of potential difference for the same current and length of arc, one corresponding to the quiet and the other to the hissing stage. With the iron arc there is no definite crater. Each electrode terminates in a viscous incandescent globule, apparently magnetic oxide of iron. When the arc is hissing strongly the discharge seems to take place from a small area on the surface of this globule. A large increase in diameter of the electrodes is accompanied by only a small increase in the value of the critical current. This varies between 0.8 ampere and 1.5 amperes, over a wide range of values of length of arc and thickness of electrodes. With the arc burning on the quiet stage in the neighborhood of the hissing point, hissing can be precipitated by shortening the arc. After the current has been increased somewhat beyond the hissing point the arc begins to rotate rapidly, producing a ring instead of a spot of light on the anode. This phenomenon is accompanied by a high-pitched whistle which degenerates into a sputter and finally turns into a steady hiss as the current is further increased. At the beginning of the whistling stage the arc has a curious tendency to jump back into the quiet stage. It is possible that slight irregularities in the electromotive force supply may serve to precipitate the change from one stage to the other, even though the current be not that at which the change normally takes place.—*Abstracted from Nature (London), August 30.*

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

COSTS OF, AND RESULTS FROM SOLICITING AND ADVERTISING.[1]

BY HOWARD K. MOHR.

In compiling a report on this subject the endeavor has been to get away as far as possible from an expression of personal opinion, and to ascertain the facts in connection with the cost and efficiency of soliciting and advertising as demonstrated by the methods in vogue and results obtained by the member companies, the subject of rates being excluded.

To this end thirty-one questions were framed, eighteen on soliciting and thirteen on advertising, covering the subject broadly. These questions were printed upon sheets for convenient reply and mailed to every company in the association. It was realized that certain questions, particularly some of those on advertising, would not receive many answers, due to the fact that some of the companies are not advertising systematically; but it was the hope and expectation that more of the companies would have given full and frank replies than has actually been the case.

For convenience of reference the questions submitted are herewith reprinted.

SOLICITING.

1. Gross revenue per year, of your company, for light and power for commercial business, exclusive of municipal business and merchandise sales.
2. Average cost of soliciting for past three years, charging to this account all expenses for securing new business, except advertising.
3. State number of contracts closed and 16-candle-power equivalent, 1905, as compared with 1904, these figures to be exclusive of increase of installation of old customers.
4. Give number of solicitors employed at present and average number during the year 1905. State number whose work is wholly soliciting and the number of solicitors who have mixed duties.
5. What is the average salary of your solicitors per year (not including heads of departments).
6. State methods of payment of solicitors, whether salary or commission or both; and on what basis do you pay commission? If you have changed from one system to the other what has been the result?
7. Do you allow premiums of any kind for successful work and on what basis?
8. State the average number of contracts secured per solicitor per year. (This refers to solicitors only; do not include heads of departments.)
9. State the average amount of new business secured per year per solicitor in 16-candle-power equivalent. (This refers to business secured by solicitors only; do not include heads of departments.)
10. Into how many branches is your soliciting department divided? Name them, prescribing the duties or limitations of each branch.
11. Do you allow commissions to architects, engineers, builders, wiring or motor contracts, and on what basis? If so, does it aid you in securing new business, and to what extent?
12. Do you divide your territory, giving a stated section to each solicitor, or do you permit each to extend his work in whichever direction he can secure contracts?
13. Describe your follow-up system for checking solicitors' work.
14. How often do your solicitors meet for general conference, and how freely may they discuss existing conditions at such conferences?
15. State how many inhabitants there are in your city for each solicitor employed. Answer this question by dividing your population by the total number of your employees who do the work of soliciting.
16. What was your percentage during 1905, of business connected to business removed from your circuits? In other words, for every 100 16-candle-power equivalent connected to the system, how many 16-candle-power equivalent were lost?
17. Do you employ women for soliciting in the residence district? If so, are they successful and why?
18. What general or specific rules do you follow in the matter of making investments for installation incident to getting new business? Please divide your answer as follows, stating method in each case:

a. Do you make free sign installations?
b. Do you make free motor installations or do you make use of a loan proposition?
c. Would you make the investment necessary to change an elevator from hydraulic to electric?
d. Do you do any wiring free of charge (residences or stores)? Do you supply first installation and free renewals of special lamps, such as the High Efficiency and Nernst lamps?
e. In shutting down isolated plants, do you aid in financing the electric installation, and how?

ADVERTISING.

1. What did you spend on advertising during the past year, excluding the cost of your bulletin, if you publish one?
2. State the cost of each subdivision of your advertising account, such as newspapers, follow-up advertising, street-car advertising, miscellaneous.
3. State the total number of direct replies received to advertising for one year.
4. State the number of contracts closed during the year 1905 by following up actual replies received. Exclude all contracts closed with parties whose names are on your mailing lists but who made no direct replies to advertising sent out.
5. Using the number of contracts closed as per Question 4, state the 16-candle-power equivalent of this business and the estimated yearly value of the same.
6. How do you check up the results of newspaper advertising? Do you look upon newspaper advertising for the central station as a measure of policy or as furnishing a direct return, or do you think it is partially one and partially the other?
7. What in your opinion is the best method of advertising for the central station with a limited appropriation; in other words, if an appropriation of from $5,000 to $15,000 were made, would you spend it in newspaper, follow-up, or street-car advertising, and why?
8. How much per capita of population in your territory did you spend on advertising during 1905? (Include all advertising expenses.)
9. In a follow-up system, which do you consider the better policy—frequent communications of average workmanship as to printing, designs, etc., or fewer communications of higher grade? How often each month or year would you circularize a given list?
10. What did your bulletin cost you during the year 1905?
11. How did you compile your mailing lists and what method do you pursue in keeping them up to date?
12. Give whatever data you have showing the advertising value of electric signs.
13. Send a copy of what you consider the most efficient advertisement you have ever issued, judged by actual replies or sales resulting from the same. Also a copy of the best newspaper advertisement; the best mailing card; the best circular letter; the best booklet, judged by the same standard; with percentage of replies received to pieces mailed (if the latter is possible). Also send a copy of your most effective bulletin cover.

SOLICITING.

Cost of Soliciting—Questions 1, 2, 4, 5 and 15 deal directly with the cost of soliciting. They were framed with the thought that the answers would indicate a more or less definite method of determining how much money should be spent in order to get business in proportion to the revenue of any one company or the population of the territory covered, etc.

The gross revenue exclusive of municipal business was asked for, inasmuch as the latter is obtained, as a rule, without the aid of the soliciting department. An analysis of the replies obtained discloses the fact that the cost of soliciting for all companies approximates one per cent of the gross revenue. That figure seems to hold, with two exceptions, in all companies whose gross revenue is under $1,000,000 per annum.

The cost of soliciting for companies whose gross revenue falls between one million and two and one-half millions falls

[1] Abstract of a paper read before the Association of Edison Illuminating Companies, Frontenac, Thousand Islands, N. Y., September 4, 5 and 6, 1906.

below one per cent and then takes a jump to one and three-quarters per cent for the companies that have a gross revenue of three million dollars and over.

If allowances are made therefore, for the element of difference in bookkeeping, the figure of one per cent of gross revenue exclusive of municipal business as applied to the expense of a business-getting department would seem to be the accepted annual cost among central stations. It may, or may not, however, be significant that as a company approaches the two-million-dollar class it seems to reduce its proportionate expenditure with a proportionate reduction in business-getting results as shown by the per cent increase in new business. When a company breaks into the three-million-dollar class, however, there appears to be a sudden awakening to the fact that liberal expenditure is required if largely increased revenue is an object, and here we see the cost of the business-getting department almost doubled.

Would these facts tend to prove that the cost of an efficient business-getting department should approximate two per cent rather than one per cent of the gross revenue per annum? If it has proven a wise expenditure for the three-million-dollar company, why not for the half-million-dollar company?

Questions 4 and 15 were asked with the idea that there might be some reasonable indication of how many solicitors would be required to cover a given field, worked out on the population basis. The result was unsatisfactory, the population per solicitor varying from 10,000 to 75,000. Twenty-five thousand of population per solicitor seems to be an average figure for the smaller companies, although we find one $500,000 company that employs no solicitor at all. In the larger cities there is a great divergence in these figures, although it should be noted that among the five largest cities the companies who show the greatest connected load per capita have the smallest number of people per solicitor, showing that it pays to cover your field thoroughly.

There appears to be considerable unanimity among the member companies as to the proper average salary of a solicitor, the figure of $900 per annum being that which appears most frequently. The business of selling electricity requires expert salesmanship. It frequently requires a certain technical knowledge. The public as a whole knows little about electrical terms or costs. They can be interested and finally convinced only by salesmen who understand their subject fully and talk of it enthusiastically; above all, they resent the sending of a boy to do a man's work.

Can you get any more than an average man for an average salary of $75 per month? You certainly can not get an expert salesman!

Straight salary without premiums is the almost universal method of paying a solicitor, but it is safe to say that the majority of central station managers would like to be convinced of the efficacy of a commission in increasing a solicitor's initiative.

The average solicitor working for a stated salary is prone to fix a certain number of contracts closed monthly as a standard. If he approximates that standard he is content, or nearly so. Would not a commission in addition to his salary (based on lamp equivalent contracted for and connected) on all lamps over a certain determined number per month provide the necessary fillip to his jaded soliciting consciousness?

Three companies who answered this question pursue a combination salary and commission method of paying solicitors. One answer is as follows:

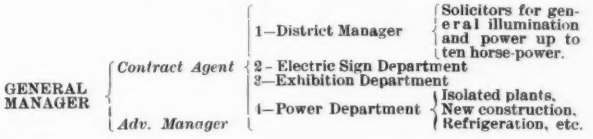
"Each solicitor is allotted a certain number of sixteen candle-power equivalent to obtain each year, and a commission is paid on all above eighty per cent of this amount on a basis of fifty cents for each customer obtained and one cent per each sixteen candle-power equivalent. About eighteen months ago we changed to the above basis with good results; the majority of the solicitors obtaining considerably more business since that time. This year we have changed from the yearly basis of paying commission to the monthly basis, with the result that a solicitor who before did not obtain a commission is now receiving a commission every month."

It would be exceedingly interesting and instructive if the representatives of those three companies would give us the benefit of their experience in this matter, with a little further information as to the details involved.

Methods of Handling the Solicitor—Questions 6, 7, 10, 12 and 14 were asked for the purpose of bringing out the various methods of handling the solicitor and developing his capabilities and resources.

The answers to Questions 10 and 12 brought out nothing that is new. The smaller companies who do not employ more than five to eight salesmen do not subdivide the work of the soliciting department. The general rule seems to be to allow them to get business of any nature when and how they can. As the companies develop, however, there is a tendency—a necessity is probably a better word—to break up the soliciting department into distinct branches. This phase reaches its highest development in the business-getting organization of the largest five or six companies, and here we find that tendency towards specializing which is present to a large degree in almost all manufacturing operations of magnitude.

A composite organization of the soliciting department of the large companies would be approximately as follows:



The popular method of keeping track of the solicitor's work is through the medium of the daily report, either directly to the contract agent or, in some cases, to the district manager—some of the companies have the solicitors make daily written reports of visits made, including date and result of each visit. These reports are forwarded daily to a record clerk at the main office for file and follow up.

Probably the newest feature of the business-getting department of a central station is the monthly solicitors' meeting held by a few of the companies. These meetings are not unlike training schools. They are presided over by the contract agent, and papers are prepared in advance and read each month by the engineers, district managers, and other employees. These papers are on a variety of subjects germane to the business-getting department and perforce of interest to the solicitor. After the papers are read a general discussion follows, in which all employees present are expected to take part. These meetings are in effect miniature Edison conventions, and should at least tend to increase the efficiency of a solicitor.

The Results of Soliciting—How may we properly gauge the results of soliciting—the efficiency of a soliciting department and the individual solicitor? Questions Nos. 3, 8 and 9 were intended to bring out answers which would throw some light

upon this subject. The result has been bewildering.

There are those who will at once say it is impossible to judge a solicitor's work in New York by comparing it with the work of a solicitor in a town of 50,000 inhabitants, and that the temperament and requirements of people living in different sections of the country vary so greatly that a comparison such as this would be worthless.

The question is debatable.

If allowances are made for varying conditions it may be possible to agree upon some middle ground, some approximate standard. It does not seem reasonable that such a great variation should exist between companies operating in cities of approximately the same class, as is shown by the answers received to the above questions.

If we except the solicitor who is engaged upon special work, isolated plant investigation and follow-up, for example, is it possible to agree upon a reasonable number of contracts which the general solicitor may be expected to secure in a year's time?

The average number of contracts secured per solicitor for different member companies in all sections varied from 110 to 494 per annum, but that fact does not prove that comparison is impossible, for the above-mentioned averages applied to two cities of the same class!

The average number of contracts secured per solicitor per year for all companies who replied to this question was 240. This is not an average of an average, but is the total number of contracts for all companies divided by the total number of solicitors.

The smaller companies averaged up to this figure very well; in fact, the majority of them ran above it. It would therefore seem that a company located in a city of the first class without competition should find food for reflection, if its figures fall below the average mentioned.

The average number of contracts secured per solicitor may be affected by the fact that one company will have a greater number of solicitors in proportion to the number of prospects than another, and there are, no doubt, other qualifying circumstances, but this data may be an entering wedge, or may at least suggest other methods of arriving at some conclusion in this matter.

One of the member companies during the year 1905 secured 20,000 new contracts (averaging 494 per solicitor); this same company used the combination salary and commission method of paying solicitors. Is there any significance in this fact, or is there some other explanation for these truly remarkable figures?

A yearly compilation of figures bearing upon soliciting results, with the sincere cooperation of the member companies, should prove of practical value to the central station manager.

Proportion of lamps disconnected to lamps connected each year may not have any direct bearing on the cost and results of soliciting except as an index of the character of the business secured, but, on the basis of "a penny saved is a penny earned," it is important.

Fifty-six lamps lost to 100 gained appeared to be the highest figure in the answers received to Question 16, varying from that number to 20 lost to 100 gained as a minimum. An analysis of the answers received would seem to show 43 lamps lost to 100 gained as an average, with 40 to 100 as a figure to be striven for.

WARRANTABLE INVESTMENT TO SECURE NEW BUSINESS.

It would be entirely impossible to do justice to this subject within the confines of a report. There is perhaps a greater divergence of opinion and treatment of this matter among central station managers than any other problem which they have to face. And nowadays the condition is met almost daily of losing business or gaining it by either making investment or refusing to do so.

The policy of making free sign installations seems to be generally accepted as good practice. Free signs have proven big money earners wherever tried and there seems to be no difference of opinion on this point. A number of the member companies, however, in the face of these results, do not as yet take advantage of this opportunity for advertisement and increased income.

A reasonable method of making free sign installations, in use by one of the member companies, is as follows:

Term contract of two or three years, with monthly guarantee (depending upon number of lamps and cost of sign) the sign and wiring remaining the property of the company.

Very few of the companies make free motor installations. One company sells the motors at cost; another makes a free trial loan of thirty or sixty days, motor to be paid for at end of that time if satisfactory; a third rents motors "on occasion at so much per month." There is apparently no well-tried-out method.

None of the companies makes the investment necessary to change an elevator from steam hydraulic to electric hydraulic.

The matter of free wiring is handled in a variety of ways. Many companies do no free wiring of any description; some do free wiring for outside arc lamps only; others do free wiring for incandescent window lighting, and when policy demands it in order to retain old business. One company does free wiring if the prospective customer is of the long-burning variety; in practically all cases this same company pays for the wiring in free current. For example, if a man makes an expenditure of $100 in wiring, the company allows him to use $100 worth of current at regular rates without charge.

In shutting down isolated plants and substituting central station service, the larger companies furnish the bulk of experience. There is a disposition to aid in financing this change by the purchase of the steam machinery at second-hand valuation. Where the size of the prospective business demands it, the old plant is purchased at a high valuation, the company so doing taking a chance of losing a little on re-sale; necessary wiring is sometimes done free of charge, where it is necessary in order to connect the business to the company's circuits. There is no fixed rule apparently in handling such cases; each company does what it has to in order to secure the business, the amount of investment by the company depending upon the shrewdness or demands of the prospect.

It ought to be possible by discussion and free exchange of experience to determine what is legitimate and what is illegitimate investment in order to secure new business, and also to agree upon a more or less certain method of handling the individual cases arising where investment is necessary.

ADVERTISING.

Starting with the premise that advertising is not only a good thing but also an essential adjunct to the business-getting department of a central station, how may we determine the proper expenditure and the reasonable results to be expected therefrom?

There is such a paucity of reliable information upon this subject, as evinced by the incomplete replies received to the questions asked, that it is extremely difficult to arrive at any definite conclusions. Only four member companies turned in a complete set of answers; quite a number of the companies answered in part; some kept no records, and others did no advertising at all.

Questions 1, 2, 8 and 10 of the adver-

tising section are concerned directly with the cost of advertising, with a view of determining the amount of an appropriation in comparison with the gross revenue[1] of any one company.

Advertising costs of the member companies varied from one-quarter of one per cent to two and one-half per cent of the gross revenue, the average figure being one and one-quarter per cent. One of the smallest companies furnished the highest figure of two and one-half per cent and the average expenditure of the larger companies was close to one and three-quarters per cent of the gross. It would seem therefore that the companies who do advertising in the most systematic manner are very closely approximating the figure of two per cent of the gross revenue mentioned some time ago.

A central station about to start a systematic advertising campaign and not knowing how much to appropriate for the purpose might determine on two per cent of the gross revenue as a very good figure, judging from the experience of the other member companies, but to state that two per cent is the proper amount for all companies might be misleading and contrary to fact. One of the best-known men in the advertising world covered the question of advertising appropriation as follows:

"How much can be judiciously spent for advertising depends largely on the possibilities of the business. If the field is such that the business can be increased indefinitely, the amount of money that can be judiciously paid for advertising is only limited by the ability to pay. Where the field is limited and only a certain amount of business can be developed any way, the advertising appropriation should be governed accordingly."

Having obtained an appropriation for advertising, how may the money be spent to the best advantage?

Questions 6, 7, 9, 11 and 12 were framed to bring out the experience and judgment of the various member companies upon this subject. An analysis of the answers received shows a considerable unanimity in thought regarding the most efficient method of expenditure, and a composite opinion upon the handling of a given appropriation would be approximately as follows:

Spend three-fifths of appropriation upon a follow-up campaign of direct mail advertising.

Spend one-fifth of appropriation upon newspaper advertising and street-car advertising.

[1] Gross revenue, as per Question 1, soliciting section.

Spend one-fifth of appropriation upon miscellaneous advertising, including bulletin, stuffers for bills, etc.

There is a distinct feeling that a series of novelty mailing cards, fac-simile typewritten letters, booklets, etc., judiciously interspersed and mailed to carefully compiled lists, is far and away the most efficient and resultful kind of advertising for the central station. There are several reasons for this, one of them being the nature of the commodity we have to sell and its necessary appeal to distinct classes.

Power users are a distinct class; so are users of electric signs; so are users of electric light, although in less degree; the percentage of people also who can not afford to wire their dwellings for electricity is considerable.

It follows, therefore, that the large percentage of waste circulation inevitable in newspaper advertising reaches its maximum in the case of the central station. Added to this is the difficulty of telling the electrical story properly and fully in the advertising columns of the newspapers without utilizing more space, at greater expense, than would be commensurate with results obtained.

The function of newspaper advertising for the central station appears to be threefold, namely, educational, supplementary, and as a measure of policy. As an educational factor, in letting the public at large know what you are doing—creating an interest and, if possible, a pride in your organization as a municipal institution—it is valuable; in supplementing and emphasizing your follow-up campaign it has its uses; from the standpoint of "good policy" it may mean a whole lot or nothing.

The money spent upon the bulletin seems to meet universal approval—the results from an educational standpoint are invaluable, and the uses which it may be made to serve are only partially realized. Stuffers of varied description, accompanying the bills, and even printed matter upon the bills themselves, bearing upon matters electrical, unquestionably serve a good purpose.

Nothing is more important than the proper compilation of a mailing list, and it is one of the most difficult problems the advertising man is obliged to face. The favorite and apparently the best method of making up this list is to have the solicitors thoroughly canvass their districts and send in the names of the most likely prospects contained therein. The value of such a list, however, depends entirely upon the sincerity of the solicitor, and the thoroughness with which he goes about his work.

In addition to the names furnished by the solicitors, the list should be filled out with names obtained from such publications as the Stationary Engineers' Directory, the Blue Book, and city directory. It should also contain the names of architects and builders and engineers and the names of prominent men in the municipality.

The data regarding the value of electric signs erected by the central stations for their own advertising purposes are not sufficiently specific to be of value.

ADVERTISING RESULTS.

If advertising is worth anything it should certainly be worth while to keep a record of the traceable results; and yet only three companies kept records of replies received to advertisements and contracts closed as a result therefrom. There are, of course, indirect results and benefits from advertising which it is impossible to measure, but the direct reply to an advertisement, with its attendant follow-up by a solicitor and the eventual signing of a contract, should certainly be a matter of record.

The simplest kind of a card index would fulfill every requirement for reference, and an office boy would have sufficient ability to take care of it.

Executive officers are apt to demand tangible results for moneys spent upon physical betterments or for an increase in the salary list, and there is no good reason why they should not demand the same thing from an advertising department, which is spending several per cent of the company's gross revenue each year.

If all of the companies kept such records, it would be possible to judge of the relative efficiency of the advertising issued, and possibly to determine upon an average cost per inquiry as well as a maximum cost, which latter figure, if exceeded, would be sufficient warrant for an organization to either change its advertising policy or seek reasons for the excessive expense.

So few companies kept track of advertising results that it serves no very good purpose to review the figures; as a matter of record, however, costs per inquiry received (considering follow-up costs only) varied from $2 to $25, and in return for expenditures during 1905, varying from $6,500 to $27,000, the estimated yearly value of contracts obtained as a direct result of "follow-up" advertising varied from three-fourths of the investment to seven times the investment, proportionate results sufficiently wide apart to be worthy of comment.

The percentage of contracts eventually closed as a result of replies received to advertising compared to the total number of replies received varied from eight per cent, the lowest figure, to thirteen per cent, the highest, which figures may have some bearing upon the efficiency of the respective soliciting departments.

An Interesting Emergency Application of Electricity.

Every once in a while the utility of electricity is demonstrated in some way which, while appearing very simple after the application has been made, in its originality called for a good deal of ingenuity and achieved results which were not possible by any other means. There has just come to our notice an interesting application of electricity which demonstrates once again the emergency utility of this form of energy. At the Philadelphia Mint a well is being bored which has reached a depth of some 540 feet. A few weeks ago one side of the jar rein

ELECTROMAGNET AND BROKEN TOOL.

of the drill, eighteen inches long and weighing nineteen pounds, broke off and wedged cross-ways in the hole at the bottom. The contractor doing the work fished for ten days trying to recover the broken piece without result, as he was unable to get hold of it, the bore being through rock. He had about decided to abandon the well when Peter E. Apgar, chief electrician of the mint, volunteered to get out the broken piece. Mr. Apgar took a piece of steel shaft, three inches in diameter, placed on one end a spool, seven inches by nine and one-half inches, wound with No. 18 cotton magnet wire, covered this with a copper sheathing, and attached to it a piece of No. 14 braided Okonite wire. The splice from the magnet to the wire was covered with a piece of lead pipe and filled with paraffine to make it watertight. The electromagnet thus constructed was lowered to the bottom with the current off. Current was turned on, 220 volts, one and one-quarter amperes. The electromagnet was then drawn up, bringing with it the broken tool and all the metal particles that were in the well from the boring. The water pressure in the bore was 250 pounds; the temperature of the water, fifty-six degrees, and the depth of the well, 540 feet. Mr. Apgar was highly pleased by the serviceability of this rubber-covered wire under these severe conditions. The accompanying illustration shows the electromagnet with the broken bar after it had been withdrawn from the bore.

The Electrical Trades Exposition Company.

The annual meeting of the stockholders of the Electrical Trades Exposition Company was held in Chicago, Ill., on Tuesday, September 11, for the purpose of electing directors for the ensuing year. The following directors were elected: Samuel Insull, Charles E. Gregory, G. H. Atkin, Stewart Spalding, Ellsworth B. Overshiner, George B. Foster, T. P. Gaylord, Homer E. Niesz, H. B. McMeal, W. W. Low and J. P. Cracraft.

At a meeting of the board of directors immediately following the stockholders' meeting the present officers were reelected as follows:

President, Samuel Insull.

Vice-presidents, Ellsworth B. Overshiner and Charles E. Gregory.

Treasurer, John J. Abbott.

Secretary, Stewart Spalding.

Managing Director Homer E. Niesz reports over eighty per cent of the floor space in the main exhibit hall of the Coliseum building already contracted for, for the second annual electrical show, to be held January 14-26, 1907.

Staff Additions for Sanderson & Porter.

Sanderson & Porter, engineers and contractors, New York city, announce that Richard S. Buck, consulting engineer of the department of bridges, New York city, has been admitted as a member of the firm. The partners in the firm of Sanderson & Porter are now Edwin N. Sanderson, H. Hobart Porter, Francis Blossom, Richmond Talbot and Richard S. Buck.

The firm covers in its operations all lines of civil, mechanical and electrical engineering, and has designed, constructed and operated steam and hydroelectric power plants, railways and lighting properties in various parts of the country.

Included in its engineering and construction work, now under way, are 50,000 horse-power of hydroelectric work in two developments on the Pacific coast; the power-house equipment and transmission system of the McCall Ferry Power Company on the Susquehanna river; extensive additions to the New Orleans street railway and lighting properties, and to those of the Mahoning & Shenango Valley Railway and Light Company, of Youngstown, Ohio, and Newcastle, Pa.

Illumination Tests.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your recent issue of the ELECTRICAL REVIEW I note that you reprint a statement of a test at Bamberger's department store, Newark, N. J., in which a Moore tube, some Nernst and some incandescent lamps are compared.

A cursory examination of the illustrations and data accompanying this article would indicate to any one having knowledge of the art of illumination that neither the Nernst nor the incandescent lamps were installed in accordance with good illuminating engineering practice. For instance, six-glower Nernst lamps were used placed eight feet six inches from the floor, with a partition in the room nine feet from the floor, so that no benefit could be derived from the units placed in one of the rooms in the opposite room or space. Six-glower lamps should never be used where the ceiling is less than twelve feet.

In conclusion, a test or a comparative statement of illuminants is of value only when all the illuminants compared are installed in a proper manner to accomplish the desired results.

MAX HARRIS.

Pittsburg, Pa., September 24.

The Association of Edison Illuminating Companies.

At the convention of the Association of Edison Illuminating Companies, held on September 4, 5 and 6 at the Hotel Frontenac, Thousand Islands, N. Y., the following officers were elected: president, Alex Dow, Detroit, Mich.; vice-president, Thomas O'Dea, Erie, Pa.; treasurer, Louis A. Ferguson, Chicago, Ill.; secretary, Ernest H. Davis, Williamsport, Pa.

Executive committee—Alex Dow, Detroit; Joseph B. McCall, Philadelphia; Samuel Insull, Chicago; J. W. Lieb, Jr., New York city; Charles L. Edgar, Boston; Thomas E. Murray, New York city; L. A. Ferguson, *ex officio*, Chicago; E. H. Davis, *ex officio*, Williamsport.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Balanced-Draft Gas-Producer Furnace.

The accompanying illustrations show the application of the balanced-draft gas-producer furnace to steam boilers. Fig. 1 shows the balanced-draft gas producer furnace as applied to a water-tube boiler with a Dutch oven extended furnace. Fig. 2 shows a front view and cross-section of the furnace.

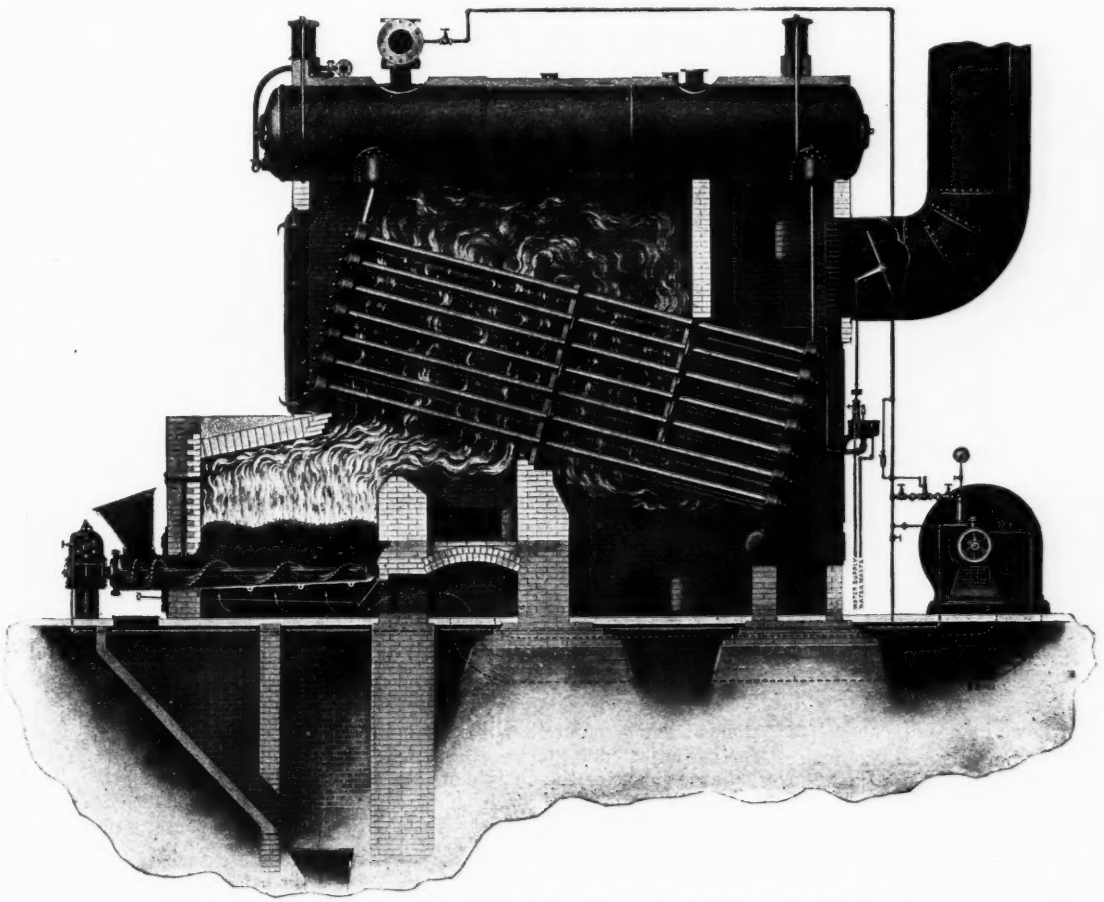


FIG. 1.—SECTIONAL VIEW OF BALANCED-DRAFT GAS-PRODUCER FURNACE SYSTEM.

The term, "balanced-draft gas-producer furnace," is an attempt to express in words the combination of certain mechanical apparatus which accomplishes the scientific, correct and commercially perfect combustion of fuel under boilers or in any furnace. At a recent meeting of the Brooklyn (N. Y.) Engineers' Club, Embury McLean, of the Engineer Company, 111 Broadway, New York city, stated that the resulting economies average about twenty-five per cent in the installations made to date, with about the same average increase in capacity. The capacity increase has amounted in exceptional instances to over 100 per cent. The "balanced draft" automatically maintains in the furnace a pressure equal to the surrounding atmosphere and limits the air introduced to the quantity required to effect perfect combustion through the entire range of demands upon the boiler. The "gas producer" part of the system is a mechanical method of feeding the coal into the furnace in such a manner that the heat of the furnace liberates the moisture and volatile matter, which combines with the requisite quantity of air, which has been heated to the temperature of combustion essentially as in a producer-gas furnace. The carbon is then consumed while passing down the inclined grates.

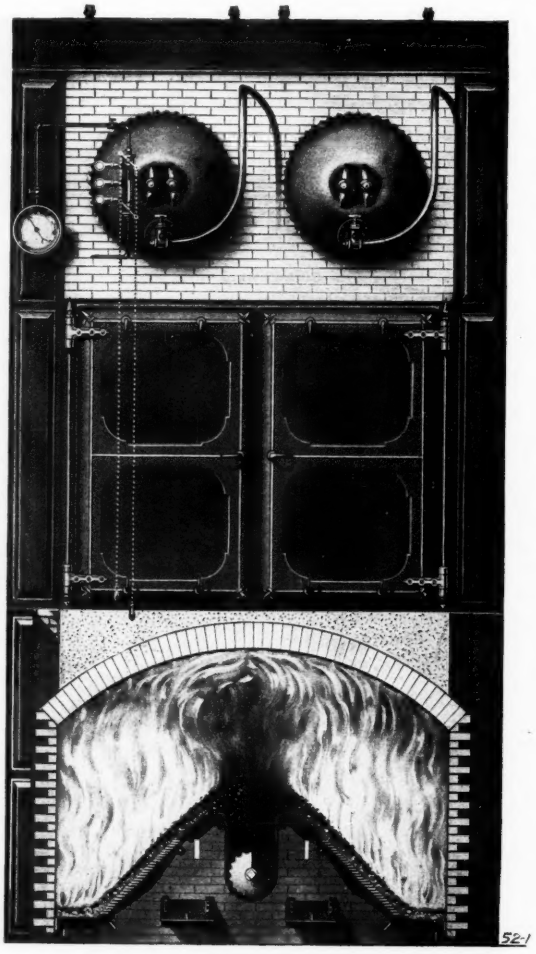
The draft is balanced by throttling the suction of the chimney in exact proportion to the speed of a specially designed fan blower which supplies air to the ash pit. The speed of the fan is governed by variations in the boiler pressure. The rate of feed of the fuel is also controlled by the variations in the boiler pressure, so that a constant ratio of air to coal is maintained for all rates of combustion. The attained result is that twelve pounds of air, combining with one pound of coal, produce maximum efficiency, maximum economy and reduce to a minimum the liability of injury to the furnace and boilers.

It will be observed in the illustrations that the conveyer worm acts as a conveyer, as such is generally understood, for about one-third of its length. The pitch of the worm of the conveyer changes just back of the front of the furnace wall from an angle in which the conveying principle

predominates to an angle in which the lifting principle predominates.

The coal is forced from the hopper through the entrance tube and into the U-shaped trough, from which it is lifted to the surface of the fire and allowed to roll gradually by gravity down the surfaces of the inclined grates, the proper inclination of which to effect the required result has been accurately determined. The variations in the pitch of the conveyer worm, in order to provide an absolutely even distribution of the coal from the front to the rear of the furnace, have also been accurately determined.

In operation the fuel assumes an uneven surface from front to rear of the furnace and has a motion similar to that of waves on the surface of a body of water, each wave corresponding to a cycle of the conveyer worm. This movement has been found to be advantageous, assisting in loosening up the fuel and freeing the volatile gases, accentuating the producer-gas furnace effect.



FRONT VIEW OF BALANCE-DRAFT GAS-PRODUCER FURNACE SYSTEM.

The Improved "Dow" Adjuster.

The Marshall Electric Manufacturing Company, Boston, Mass., has put on the market an improved form of the "Dow" adjuster, an illustration of which is shown herewith. This device is used for raising or lowering an incandescent lamp suspended from a cord. The device works like a curtain fixture, and the cords are rolled entirely out of sight.

The adjuster consists of a metal shell or barrel, inside of which is a long coiled flat piano wire spring. To this barrel is fastened an eye, around which the cord is wound, and on the end of this barrel are two pawls which engage the spindle fastened to the shell. When the adjuster is quickly released, it will go up until stopped by the hand. At the same time it can be pulled down to any desired position, at which point it will remain until further adjusted.

"DOW" ADJUSTER.

Large stocks of these adjusters are now in the hands of the branch offices of the company—227 Fulton street, New York city; 169 Adams street, Chicago, Ill., as well as the Boston works.

New Electrical Engineering Company.

The Connally-McIlheran Electrical Engineering Company has been incorporated at Chattanooga, Tenn., with a capital stock of $10,000. The engineers identified with this company are as follows: W. B. Connally, formerly electrical engineer with the Wellman-Seaver-Morgan Company; W. C. McIlheran, formerly electrical engineer for the Decatur Car Wheel and Manufacturing Company; W. C. McAfee, electrical engineer, Atlanta Steel Hoop Company, and H. A. Clark, electrical engineer, United States Cast Iron Pipe and Foundry Company.

Sturgess Water-Wheel Governors.

The accompanying illustrations show two forms of Sturgess water-wheel governors made by the Sturgess Engineering Department of the Ludlow Valve Manufacturing Company, Troy, N. Y. Fig. 1 shows the type "M" governor, producing a rotary motion at the terminal shaft. This is the standard machine for turbines having gates operated by a rotary shaft. It consists of a shaft-type centrifugal governor at the top, controlling, by means of a long vertical lever, the valve attached to the side of the cylinder. This admits pressure into the cylinder, the piston of which rotates the gate shaft by means of a concealed steel rack and pinion. This

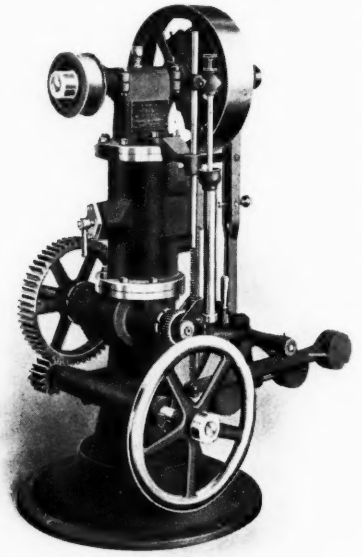


FIG. 1.—STURGESS TYPE "M" WATER-WHEEL GOVERNOR.

rack has a substantial guide, ensuring its alignment and a proper meshing of the teeth, avoiding the use of a piston rod and gland.

The compensator for preventing racing is simple in design, correct in principle, and causes the governor to make definite movements exactly proportionate to the change of load.

The centrifugal governor is of the standard shaft type, having a high power-factor to enable it to absolutely control the valve.

In the two smaller sizes the admission to the cylinder is controlled by a hardened-steel piston valve operated directly from the governor lever, the valve being set in a valve chamber bolted to the side of the cylinder.

In the three larger sizes, four poppet valves are employed to give admission and

exhaust. The poppet valves are operated by a small hydraulic cylinder controlled by the pilot valve and centrifugal governor, the piston of the cylinder being connected to an arm on a rock shaft carried

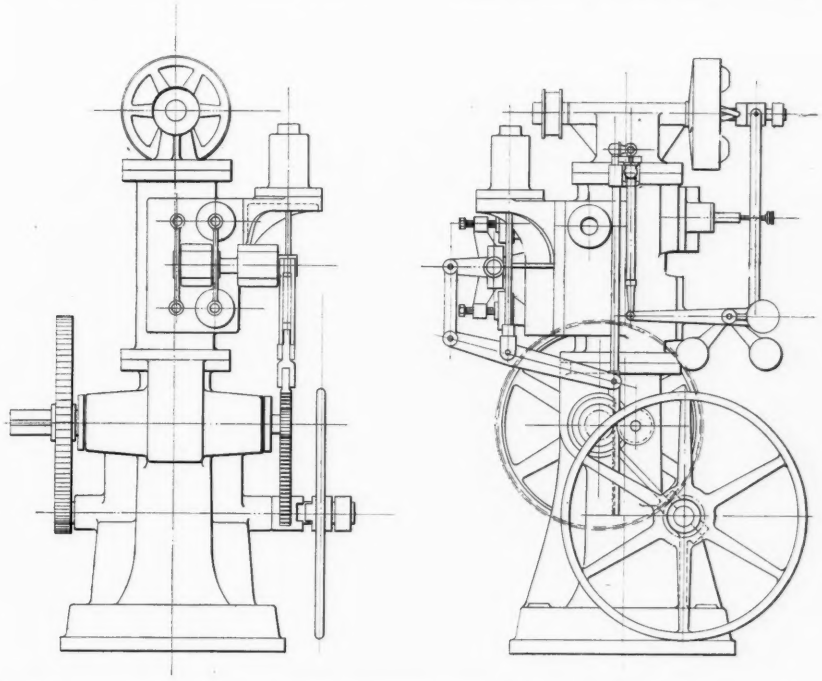


FIG. 2.—ARRANGEMENT OF PARTS, STURGESS TYPE "M" WATER-WHEEL GOVERNOR.

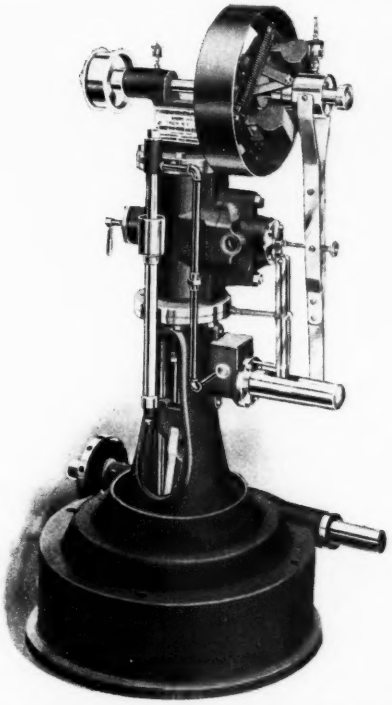


FIG. 3.—STURGESS TYPE "L" WATER-WHEEL GOVERNOR.

in bearings. The two upper valves are pressure and exhaust valves controlling the upward movement of the main piston. The two lower valves similarly control the downward movement of the piston. All valves open against the pressure.

These governors will completely open or shut the gate in one and one-half seconds. Under gradual changes of load they will maintain the speed within three-quarters of one per cent of normal. Under sudden changes of load they will promptly move the gate to the new position required by the changed load, the movement commencing before the speed has exceeded three-quarters of one per cent from normal.

Fig. 2 is a diagrammatic representation of the type "M" governor, showing the relationship of the various parts.

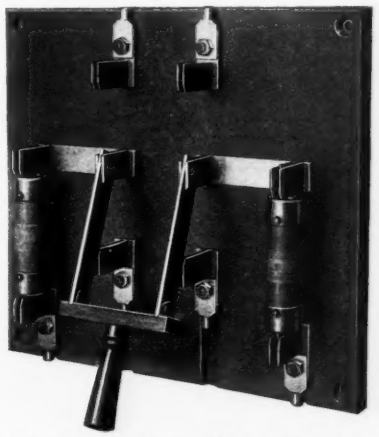
Fig. 3 shows the type "L" governor with rock shaft for producing an oscillatory motion of seventy-five degrees at the terminal shaft. The type "L" governors are similar to type "M" in all respects, except that in place of the rack and pinion and rotary shaft they have a rock shaft operated by an arm and link connection to the piston rod of the main cylinder.

The centrifugal governor valve mechanism and compensator are of the standard design, the same as is used with the type "M" governors.

The Chicago Pneumatic Tool Company reports its trade for the month of August to be the heaviest in the history of the organization, both in business booked and shipments made, the latter exceeding all previous monthly records by fifteen per cent.

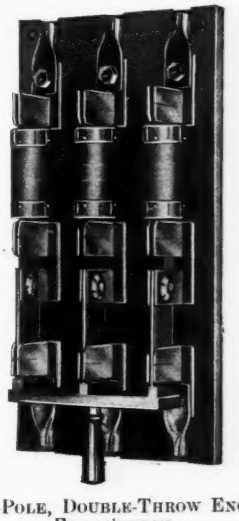
An Improved Type of Lever Switch.

The General Electric Company has recently developed a line of knife-blade switches, to be known as D-12 lever switches, which meet exactly the requirements of this class of electrical apparatus. In the first place the switch is of simple construction. Sweated joints have been eliminated so far as practicable, and such joints as are sweated are reenforced by other means of fastening. Similar parts of switches of the same capacity are made interchangeable, and the workmanship throughout is of a high grade.



DOUBLE-POLE, DOUBLE-THROW ENCLOSED FUSE SWITCH

Every detail in these switches is carefully worked out. The cross-bars are made of selected black fibre secured firmly to the blade, while the handles are made of hard wood stained black and polished, and firmly attached to the cross-bars by heavy studs and insulated nuts. In order to provide for very low rise in temperature, the contact clips are generously pro-



TRIPLE-POLE, DOUBLE-THROW ENCLOSED FUSE SWITCH.

portioned from hard-drawn spring copper, securely pinned and soldered into the clip blocks, and the hinge clips are provided with large and substantial spring washers which serve to maintain good contact by compensating the slight wear incident to long-continued use. These spring washers are provided with positively locked nuts, so that contacts are prevented from working loose in the most severe service. Hard-drawn copper is used in the construction of the blades.

General Electric switches of this type can be furnished with connections, either for enclosed fuses of the National Electric Code standard or link fuses. Single and double-pole, double-throw switches have off-set fuse connections, necessitating but one set of fuses. The standard switch for enclosed fuses is so arranged that when the switch is open the fuses are on the load side. This arrangement can be varied, however, and switches can be furnished so arranged that, when open, the fuses will be between the switch and the service. D-12 switches are made in single, double, triple and four-pole types.

The Dean Hook Switch.

The accompanying illustrations show the method of stamping and attaching the hook switch with which the Dean Electric Company, Elyria, Ohio, is equipping its standard instruments. This is said to be one of the most efficient pieces of apparatus ever constructed. The switch hook lever is made in the most substantial manner possible, and gives an exceptionally neat appearance. This hook is made by pressing and drawing it into the proper shape, by numerous operations, from one piece of heavy sheet brass. The number of operations required to form this hook compacts it in such a way as to close all the pores in the metal, thereby strengthening and hardening it so that when completed it has the appearance of a solid metal hook lever.

Fig. 1 shows the blank from which the switch hook lever is formed. Fig. 2 shows the hook switch lever as it is drawn into triangular shape at the top of the forks, ensuring great strength at this point of construction. The metal is doubled over not only at the bottom of the lever, but at both prongs, making the lever very rigid.

FIG. 1.—BLANK FROM WHICH HOOK LEVER IS FORMED.

Fig. 3 shows the completed hook switch lever, and Fig. 4 shows the self-contained hook switch with the hook lever removed. Fig. 5 shows the hook lever locked into position in the hook switch.

FIG. 2.—BLANK DRAWN INTO SHAPE.

The hook switch, in connection with the one-piece hook lever, provides an exceptional facility in allowing the lever to be removed, avoiding extra space taken up in shipping and storage, and preventing the switch mechanism from being damaged.

FIG. 3.—COMPLETED HOOK LEVER.

The lever need not be installed in position until after the telephone is mounted on the wall. When the lever is once in place it is securely locked by a spring catch and can then only be removed by opening the lid of the telephone box, as the release is located on the body of the switch.

The removing and replacing of the lever do not require tools, nor is it necessary to disturb the switch hook mechanism, which is actuated by the stub lever. This lever serves also as a lock to hold the hook lever in place and partakes of its motion when the hook is operated.

The hook switch is self-contained in every sense, and is complete in itself, even to the escutcheon, so that no dependence need be placed on the telephone cabinet for operating or holding the parts in their relative positions. It is fastened to the telephone by four screws passing through the escutcheon frame. An opening, fifteen-sixteenths of an inch in diameter, is provided for inserting the body of the switch. The contact springs are mounted on a small metal block which forms a unit.

The various combinations of springs, necessary to adapt the hook switch to different circuits, are interchangeable with the remainder of the machine. The illustration, herewith, shows the two-contact spring combination for use with a central battery telephone. The contact springs are made from the best grade of spring, German silver tipped with platinum points and insulated with hard rubber. The hook switch frame and lever are thoroughly insulated from the parts entering the circuit. The actuating or main spring is of special German make, heavy and long, with its tension applied near the fulcrum of the lever. The entire hook is finished in heavy nickel-plate and the parts are copper-plated under the nickel.

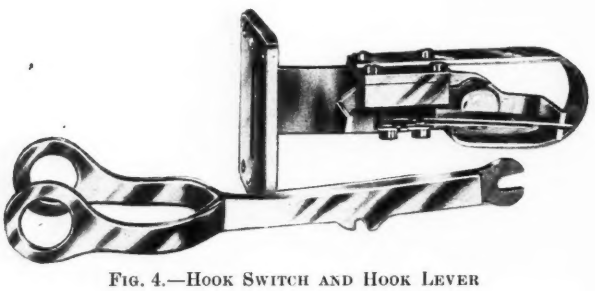


FIG. 4.—HOOK SWITCH AND HOOK LEVER

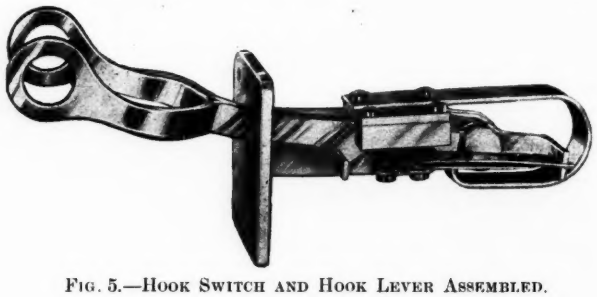
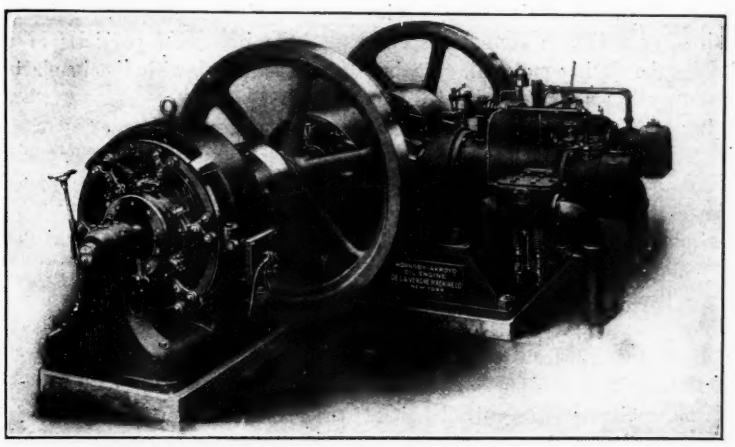


FIG. 5.—HOOK SWITCH AND HOOK LEVER ASSEMBLED.

The report of the Interstate Commerce Commission gives the gross earnings of the railways of the United States for the year ending June 30, 1905, as $2,082,482,406.

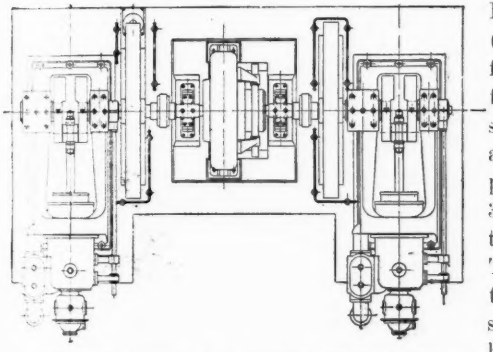
Crude and Fuel Oil Generator Sets.

The accompanying illustrations show two types of generator sets, several of



TWIN-CYLINDER OIL ENGINE WITH GENERATOR MOUNTED ON OUTBOARD BEARING.

which have recently been installed by the De La Vergne Machine Company, New York city. The engine used is the Hornsby-Akroyd, which operates on kerosene, crude or fuel oil, delivering a brake-horse-



TWIN-CYLINDER OIL ENGINE WITH GENERATOR MOUNTED BETWEEN CYLINDERS.

power-hour on a little less than a pound of oil. This machine is built in sizes from five horse-power to 250 horse-power. In the twin-cylinder type the generator is sometimes placed between the cylinders, as is shown in the accompanying diagram.

Electric Equipment for the Hudson Company's Tunnels.

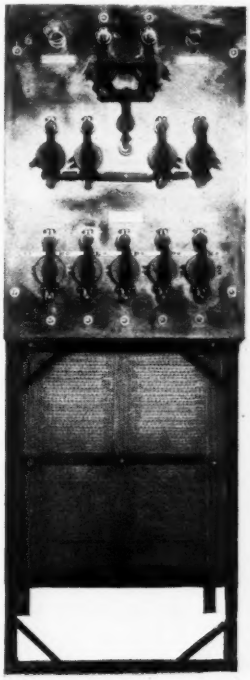
The twin tunnels of the Hudson Company, connecting Jersey City with New York, under the North river, represent the most recent development in electrical projects centering about New York city. Construction work on these tunnels was finished about a year ago and work on the electrification will begin at once. Fifty electric cars will be operated, taking their power from the third rail.

Each tunnel will have a single track; the north tube carrying the west bound traffic and the south tube carrying the east bound or New York traffic. The cars will be operated in trains by the Sprague-General Electric system of multiple unit control in a manner similar to that employed on the New York subway trains. Each car will be equipped with two GE-76 (160-horse-power) railway motors. Power for this new development will be supplied from a large station on the New Jersey side, located between Jersey City and Newark. Curtis steam turbines will be employed; initial equipments including two 3000-kilowatt, 11,000-volt machines and two 6000-kilowatt, 11,000-volt machines. The total power so generated will be distributed at high voltage to three substations where the alternating current will be stepped down to 650 volts direct-current through transformers and rotary converters. These substations will be located as follows: substation number one, Greenwich and Christopher streets, New York, containing five 1,500-kilowatt rotary converters and fifteen step-down transformers; substation number 2, Washington and First streets, Jersey City, containing four 1,500-kilowatt rotary converters and twelve step-down transformers; and substation number 3, Cortlandt and Church streets, New York city, containing two 1,500-kilowatt rotary converters and six step-down transformers. Each substation will, in addition, contain one spare 1,500-kilowatt transformer.

It is expected that when the new line is in operation the running time between the various suburban cities of New Jersey and New York city will be reduced one-half. The General Electric Company will furnish the complete electrical equipment.

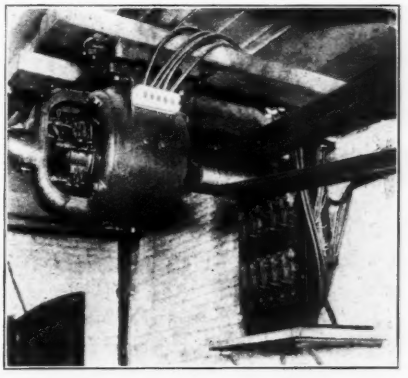
Automatic Motor-Controlling Devices.

The New York Electric Controller Company, 21-27 New Chambers street, New York city, has placed on the market what is claimed to be the most compact



ELEVATOR CONTROLLER.

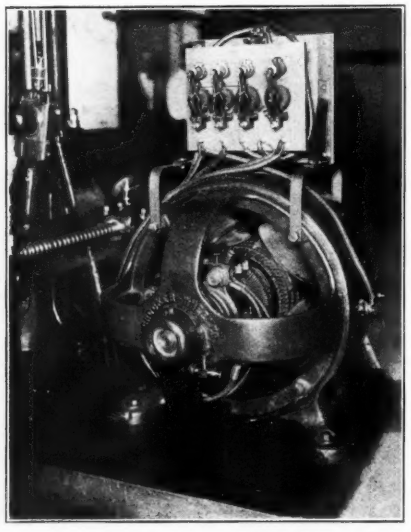
and easily operated automatic elevator controller ever designed. The accompanying illustrations give an idea of the appearance of the motor controller and its adaptability to various situations. With this motor-controlling device there are no



MOTOR STARTER APPLIED TO CEILING MOTOR.

rubbing contacts; suction air pots, cams, gears and belts are eliminated, and the apparatus works entirely without such auxiliaries as compression cylinders, retarding springs or dashpots. The action of the apparatus embodies a new invention, and the contacts are made through carbon blocks, the rocking arms being

actuated by gravity supplemented by the pressure of a light spring to overcome residual magnetism on the breaking of the circuit. The apparatus is so arranged that only such movements as have been predetermined can take place. For instance, it is impossible for one set of contacts to operate without the proper supplemental action on the part of every



Motor-Starter Fastened to Frame of Motor.

other contact on the board. Should mechanical injury or continued service necessitate the changing or repairing of any part the construction is so simple that the defective piece may be easily removed and a new part substituted at small cost.

The resistance used with this device is of special construction, the flat resistance strips being laid up upon an insulating base in such a manner as to ensure thorough ventilation.

A number of these motor-starters and controllers have been in operation for some time, so that every feature of the apparatus has been actually tried out, with, it is asserted, the most satisfactory results. G. A. Annable is the general sales manager for this apparatus.

Vacuum Drying and Impregnating Apparatus.

The accompanying illustration shows the vacuum drying and impregnating apparatus made by the J. P. Devine Company, Buffalo, N. Y., under American rights granted by the firm of Emil Passburg, of Berlin, Germany. The usual method of drying rubber by means of hot air passed through drying rooms under pressure from a fan or similar device has provoked a demand for an apparatus which would remove the moisture and at the same time eliminate the possibility of charging the drying material with deleterious substances in the form of dust which might be carried into the drying room by the fan blast. A saving in time is also desired, as well as a saving in space occupied by the drying material. Again, hot-air drying has a tendency to harden the drying material, particularly if the material be porous, by closing up its pores.

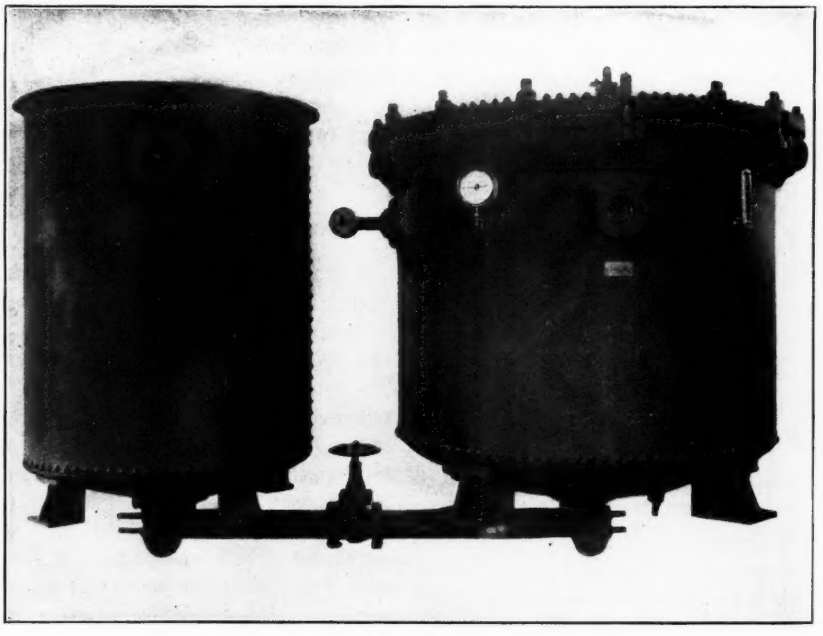
Where the rubber is to be used for electrical insulating purposes it is particularly desirable that every particle of moisture be removed, keeping the drying material at as low a temperature as possible.

With the vacuum drying and impregnating apparatus illustrated herewith it is claimed that it is possible not only to remove the moisture economically, but also to remove it at so low a temperature as to absolutely exclude deterioration in quality.

Under vacuum the slow evaporation, such as exists under atmospheric pressure, is turned into a rapid boiling of the water, not raising, but lowering, the temperature, as the boiling point is reduced from 212 degrees to ninety-five degrees Fahrenheit.

Where textile materials or porous fabrics are to be impregnated with an insulating compound the vacuum and pressure system of impregnation is found to be very desirable, inasmuch as the impregnating compound is forced into a most intimate contact with the fabric under treatment. To further improve the method of impregnation the impregnating compound is allowed to enter the vacuum impregnating vessel by means of atmospheric pressure. This is subsequently increased by adding artificial pressure (compressed air) to the required extent, so that the innermost particles of the material are filled with the insulating compound.

The enforced impregnating or combined impregnating process, under vacuum together with artificial pressure, is necessary only for materials which are of a very close texture or have to be treated with heavy compounds. The two processes, however, need not be undertaken in one vessel. The drying under vacuum may take place in one vessel, and the impregnation in another. When removing the materials from the vacuum drier into the vacuum impregnator it is necessary to break the vacuum in the former vessel and allow atmospheric air to enter it and, naturally, the pores of the insulating material. As this air only fills such pores once and can only once deposit the moisture it carries, this moisture will have no detrimental effect, as it has no circulation and but little enters anyway. In addition to this, as soon as the material is placed in a vacuum-impregnating vessel the latter, which may be fitted with heating coils, is evacuated, and the insulating material is at once freed from atmospheric air and also from any particle of moisture which it may have absorbed during its transit from the vacuum drier to the impregnating vessel.



Vacuum Drying and Impregnating Apparatus.

Current Electrical News

DOMESTIC AND EXPORT.

UNITED STATES INDEPENDENT TELEPHONE COMPANY TO ISSUE $2,500,000 NOTES—It is announced that the directors of the United States Independent Telephone Company have authorized the issuance of notes to the value of $2,500,000, to pay six per cent interest and run two years.

THE NEW YORK-CHICAGO ELECTRIC AIR-LINE PROJECT—A syndicate headed by Joseph Ramsey, Jr., formerly president of the Wabash Railroad, has applied for a charter for the construction of a trunk line across Pennsylvania, to be known as the Keystone Air Line. This is supposed to be part of the project for the road from New York to Chicago. The capitalization of the Keystone Air Line is given at $450,000.

NEW JERSEY COMMISSION TO INVESTIGATE PUBLIC UTILITY CORPORATIONS—The last legislature of New Jersey passed a law providing for the appointment of a commission to investigate the feasibility of dividing the profits of public utility corporations between such companies and the municipalities in which the properties are operated. Governor Stokes has appointed the following commission: Joseph H. McGraw, Madison; A. B. Leach, South Orange, and Alfred N. Barber, Trenton.

COLORADO & SOUTHERN TO ELECTRIFY A PORTION OF ITS LINE—Contracts for constructing an electric line from Denver to Boulder, Col., for the Colorado & Southern Railway have been signed with the Westinghouse Electric and Manufacturing Company. The plan for electrifying the steam line operating between Denver and Boulder has been abandoned. It is expected that by June 1, 1907, the electric road will be in operation and will handle much of the passenger business between the two cities.

RAILWAYS COMPANY GENERAL REDUCES CAPITAL STOCK— At the annual meeting, in Jersey City, N. J., of the Railways Company General, the stockholders authorized the reduction of the capital stock from $900,000 to $700,000. The old board of directors was reelected. The reduction of $200,000 in the capital stock was, it is understood, effected by the purchase and retirement of that amount of stock. The Railways Company General was incorporated in New Jersey in 1899, to acquire, control and operate street railways, gas, electric light and water plants. The company's headquarters is at Philadelphia, Pa.

NEW YORK CENTRAL TO INCREASE CAPITAL STOCK—The directors of the New York Central & Hudson River Railroad have authorized the issuance of $29,839,560 of stock to stockholders at par. This issue is equal to twenty per cent of the present holdings of stockholders. It is issued to stock of record October 16. The right to subscribe terminates on November 30. The proceeds of the issue are to be used for the purpose of paying for different improvement work that the company has under way, as well as to make provision for new equipment. A portion of this issue will be applied to the expenditures incurred in connection with the New York city terminal.

EXTENSIVE CALIFORNIA ELECTRIC LINE—A new double-track electric railway connecting Los Gatos and San Carlos, Cal., fifty miles long, and running along the lower slopes of the foothills in the Santa Clara valley, will, it is announced, be completed within the next six months. The Peninsular Railway Company, a corporation which is controlled by people who are prominently identified with the Southern Pacific Company, is now engaged in building the road. It is planned to build three new towns along the line. One of these will be located at the junction of the branch railroad which runs to Meridian, and thence to San Jose, and will be about nine miles distant from San Jose. Another will be opposite Mountain View station on the Southern Pacific line.

GEORGIAN BAY CANAL DEVELOPMENT—It is announced that the report of the engineer in charge of the Georgian Bay canal survey, to be presented to the Dominion parliament at the approaching session in November, will show the feasibility of a hydroelectric development of 1,250,000 horse-power along the route. It is considered that an expenditure of $100,000,000 will be justified for the increased facilities afforded for the transportation of the products of the western fields to the Atlantic seaboard by this proposed great waterway. If, in addition, the electric development is realized, there will be a much stronger incentive for proceeding with the work as a national undertaking. Electricity would not only be utilized for the varied uses of commerce, but also for developing the mineral wealth contiguous to the river.

MUELLER CERTIFICATE ISSUE DECLARED CONSTITUTIONAL—Judge Thomas G. Windes, in the Circuit Court at Chicago, Ill., on September 15 decided in favor of the city of Chicago in the injunction suit based on the Mueller law, which provides for the issuance of $75,000,000 of railway certificates by the city. The law was declared constitutional by the court, which held that subsequent ordinances regarding the purchase and operation of street railways passed by the city are in compliance with the law. The decision was a complete victory for the city, the court holding against every point advanced by the complainants in their bill, which was dismissed for want of equity. The case will now be appealed to the State Supreme Court, which, it is expected, will take it under advisement next month.

NEW TELEPHONE COMPANY—The Subscribers' Mutual Telephone Company has been incorporated at Baltimore, Md., with a capitalization of $500,000. The company expects to enter the field of active business in about thirty days, and, it is announced, will compete for subscribers at lower rates than those of the existing companies. Mutual stock ownership and the use of an automatic telephone will also be offered. The incorporators of the company are: J. Lefferts Conard, of Trenton, N. J., president; Thomas E. Weems, of New York city; James W. Owens, of Indianapolis; Charles C. Wight, of Baltimore, and Samuel B. Hardy, of Anne Arundel county, Md. Mr. Wight will be secretary-treasurer of the company. Messrs. Henry Yewell Bready and James W. Owens, general counsel, and Frank B. Bready & Company, fiscal agents.

TEXAS TRACTION COMPANY—A company with a capitalization of $15,000,000 has been organized at Galveston for the purpose of constructing and maintaining several hundred miles of electric road in the state of Texas. The capital is all from the state of Texas, and it is expected that the new organization will absorb the Texas Traction Company, of Dallas, which owns several electric light and power plants in north Texas. The contract has been let to Suderman & Dolson, contractors of Galveston, for building an interurban electric line between Dallas and Sherman. The contract also includes power-houses and substations. The main power-station and shops will be located at McKinney. Among those interested in the enterprise are J. F. Strickland, of Dallas; William H. Bean, Howe; E. M. House, Austin; John S. Heard and J. L. White, of McKinney; F. F. Dumas and George W. Bowman, of Austin.

NEW PUBLICATIONS.

COLUMBUS, OHIO—The board of trade, Columbus, Ohio, has published a portfolio illustrating and describing the principal features of the city of Columbus. This portfolio is replete with interesting data and certainly reflects great credit upon the city.

GAS-DRIVEN ELECTRIC POWER SYSTEMS—A paper presented before the Engineers' Society of Western Pennsylvania, June 5, 1906, by J. R. Bibbins, entitled "Gas-Driven Power Systems as Exemplified in the Warren & Jamestown Street Railway," has been reprinted by the Westinghouse Companies' publishing department, by courtesy of the society.

ELECTRIC RAILWAYS.

MEMPHIS, TENN.—The Memphis Street Railway Company will erect a new car barn at a cost of $100,000.

ASHLAND, VA.—The track-laying of the new electric line has been completed almost to the Chickahominy river, and it is expected that the line will be in operation early in December.

ALBION, N. Y.—Engineering and grading for the roadbed of the Buffalo, Lockport & Rochester trolley road is being done east of Holley and at Knowlesville, west of Albion.

SAN FRANCISCO, CAL.—The ordinance granting the Presidio & Ferries Railroad Company the privilege of using electric traction on all of its lines where the grades will permit has been passed.

FORT WORTH, TEX.—The election held to decide whether or not a franchise should be granted to the Northern Texas Traction Company to operate on additional streets resulted in the company's favor.

BROOKLYN, N. Y.—The New York & Long Island Traction Company has inaugurated a direct service from Jamaica to Hempstead and Mineola, connecting with the Freeport and Rockville Centre trolley line.

AKRON, OHIO—Among other improvements being made by the Northern Ohio Traction and Light Company which will greatly add to the transportation facilities of its lines, is the double tracking of the Akron, Bedford & Cleveland line through Bedford.

CHEYENNE, WYO.—The Northern Colorado Power and Light Company, which recently purchased the plant of the Cheyenne Light, Fuel and Power Company, is considering the establishment of a system of street railways in Cheyenne, connecting Cheyenne with Fort Russell.

RICHMOND, VA.—The Henrico board of supervisors has given the Virginia Power and Passenger Company a ten-year franchise to build a road out the boulevard from Broad street to the new fair grounds on the north side of the Richmond, Fredericksburg & Potomac Railroad.

ATLANTA, GA.—Work will be begun on the Hapeville extension of the East Point car line of the Georgia Railway and Electric Company by the first of January next. By the latter part of spring it is the purpose of the company to operate on a regular schedule between Hapeville and Atlanta.

COLUMBUS, OHIO—A further extension of the Schoepf-Morgan interurban lines is being planned which will give Columbus an opening into territory hitherto rather difficult of access. This is the extension of the Scioto river line to Plain City, Marysville and possibly further north to Bellefontaine.

CASTLEDALE, UTAH—Don C. Robbins, of Salt Lake, has applied to the commissioners of Emery county for a franchise to run an electric railway on the highways of the county. The northern terminal of the road is to be at Mound, on the Rio Grande Western, and the entire line will be in Emery county.

TERRE HAUTE, IND.—The Terre Haute Traction and Light Company this year will expend something over $600,000 in adding to its Water street power station, reconstructing and realigning a considerable portion of the Brazil line, building a transmission line between Terre Haute and Brazil, and erecting substations at Seelyville and Brazil.

AUSTIN, TEX.—Warren Bicknell, John A. Harper, J. B. Nutt and E. W. Christy, all of Cleveland, Ohio; W. O. Allen, of Fostoria, Ohio, and Cary B. Close, of Toledo, Ohio, are named as the incorporators of the Citizens' Railway and Light Company, of Fort Worth, Tex. The company has a capital stock of $1,000,000, and is organized to build a system of interurban railway radiating out of Fort Worth.

BUFFALO, N. Y.—Ground has been broken for the new trolley line along the lake shore that will eventually give Buffalo a trolley connection with Erie, Pa., this being the line which former Lieutenant-Governor William F. Sheehan, of New York, and Joseph B. Mayer, of this city, have promoted, and which will come in to Buffalo over the Buffalo & Hamburg line and a new extension along the Hamburg turnpike.

SALT LAKE CITY, UTAH—After negotiations that have been carried on for some time, the Utah Light and Railway Company has agreed upon terms and signed a contract to furnish power for the Ogden Rapid Transit Company's lines for a period of seven years, commencing with the first of the year. This agreement will mean the abandoning of the Washington avenue power-house. For a long time this has been inadequate to the demands for power to operate the lines of the transit company.

ALBANY, N. Y.—The Paul Smith's Electric Light, Power and Railroad Company has been granted authority by the State Railroad Commission to build an electric line about nine miles long through the Adirondacks from Lake Clear railroad station in the town of Harrietstown, Franklin county, to Paul Smith's, at Saranac, with a branch from the main line to Upper St. Regis Landing. The company was incorporated by Paul Smith and others some time ago and has a capital of $100,000.

WHEELING, W. VA.—The Dillonvale & Ohio River Traction Company, which proposes to construct a traction line from Portland station or Rayland to Dillonvale, has the survey completed. One of the officials of the company stated that he was not prepared to say that the line would be built this fall, but that it was most probable that some of the grading would be done. The line will be six miles long and will connect with the new extension of the Steubenville & Wheeling Traction Company at Rayland.

NORTH ADAMS, MASS.—Extensive plans are on foot for the rebuilding of the Hoosac Valley street railway system next spring. They call for the rebuilding of the entire old part of the system, making it modern in every particular, and the elimination of many grades and curves on the Williamstown line, which is to connect with the new Bennington-North Adams electric railway, in order to make an hourly run between North Adams and Bennington possible. One of the new features will be the installation of a new telephone system with a central office in Pittsfield.

BIRMINGHAM, ALA.—The Tidewater Development Company, which has undertaken to build a double track electric railroad from Tuscaloosa, on the Warrior river, to Gadsden, on the Coosa, a distance of 115 miles, the road to pass through Birmingham, has about completed the surveys for the line, and actual construction, it is announced, will begin soon. When the road is in operation it will connect with steamship lines which are to be established on the Coosa river at the northern terminus and on the Warrior at the southern terminus. The road will be for both freight and passenger traffic.

POTTSTOWN, PA.—Trolley service between Philadelphia and Harrisburg before July 1, 1907, was promised at a meeting of town council by Superintendent George Hoeger, of the Schuylkill Valley Traction Company. The promise was made after council had passed the ordinance granting the Pottstown & Northern Company the privilege to widen its tracks, for which right $16,000 is to be paid. The latter road, which was formerly the old Ringing Rocks line, will now be purchased by the Schuylkill Valley Traction Company, and used as a link in its Reading-Philadelphia trolley system. The sum of $28,000 is to be paid for it, which does not include Ringing Rocks Park.

MAHONINGTOWN, PA.—The right of way for a trolley line from Mahoningtown to Morado Park has been secured and plans for the construction of the line are now being considered. When this line is running there will be not only a complete trolley system between New Castle and Pittsburg, but it will be possible to go from New Castle almost to Sisterville, W. Va., without interruption. With the breach between Morado Park and Mahoningtown covered, it will be possible to go by trolley through Youngstown to Cleveland about fourteen miles north of Leavittsburg. This breach will be tracked within a short time, making a continuous trolley system from Pittsburg to Cleveland.

JACKSON, MISS.—The Claremont Railroad Company has applied to the governor for a proclamation authorizing organization. The prime movers in the enterprise are R. K. Jayne and M. Jayne, of Jackson; William Walker and others, of Brandon. The idea is to connect Jackson with several of the neighboring towns by electric road. Brandon, Clinton, Raymond, Coopers Well and other places will come in on the line if sufficient encouragement is given. The scheme is not only to build a trolley line, but to furnish electric lights to the several towns en route. This line will in no way interfere with the line projected from Jackson to Vicksburg, though they will parallel from here to Clinton, a distance of ten miles.

TELEPHONE AND TELEGRAPH.

MONTPELIER, VT.—The Orange County Telephone Company is planning to extend its lines from Barre and Northfield into this city.

MARTIN'S FERRY, OHIO—The American Telephone and Telegraph Company is building a long-distance line from Martin's Ferry to Columbus, Ohio.

BRATTLEBORO, VT.—A new telephone line has been placed in operation, connecting with Williamsville *via* South Wardsboro, East Dover and South Newfane.

PASCO, WASH.—The Independent Telephone Company has secured a franchise at Pasco, and will put in an exchange which will have long-distance connections.

QUEBEC, QUEBEC—The system of the Bell Telephone Company, of Canada, has been further extended by the completion of a line from St. Raymond to St. Leonard de Portneuf.

OAKLAND, CAL.—The Sunset Telephone Company has installed an additional cable between Oakland and San Francisco, in order to increase the efficiency of the long-distance service.

SPOKANE, WASH.—The Independent Telephone Company has its chief engineer, H. A. Zahm, in the Big Bend country, south of Spokane, looking over the field with a view to putting in a line.

HUBBARDSTON, MASS.—Workmen employed by the New England Telephone and Telegraph Company are engaged in stringing wires from the Hubbardston exchange to Barre by way of Williamsville.

SHARON, OHIO—The Bell Telephone Company is contemplating underground wires, a new office building and new common battery system at Sharon. The proposed improvements, plans for which have been made, will cost about $200,000.

CHICAGO, ILL.—The Chicago Telephone Company will establish an extensive division headquarters at the northeast corner of Fillmore street and South Forty-first avenue. The headquarters will comprise a barn and large warehouse for storage purposes.

BOSTON, MASS.—An entirely new operating plant has been put into commission by the New England Telephone Company in the South Boston exchange district. It is located in a specially constructed building and its equipment embodies the latest improvements.

BROCKTON, MASS.—An acceptance of the telephone franchise has been filed by the Home Automatic Telephone Company. The acceptance is unconditional, as required by the terms of the franchise, the company assuming all conditions and requirements therein without reservation.

LITTLE ROCK, ARK.—A local telephone system will be established at Sulphur Rock, work on which is now progressing. The capital stock of the company is $2,000, and the officers are: Sam Tuggle, president; J. K. Rawlings, secretary; W. R. Rice, treasurer, and J. C. Gill, business manager.

PHILADELPHIA, PA.—The Bell Telephone Company has had work begun on its new exchange, at 1632-1636 Diamond street, to be known as the Diamond Exchange. It will be of hard brick, forty-four feet one and one-half inches by 102 feet 2 inches in dimensions, and will cost $40,000.

LEAVENWORTH, KAN.—The People's Home Telephone Company has begun work on the laying of the new underground conduits in the business portion of the city. This work will be the preliminary portion to the installation of an entirely new telephone system. Its completion alone will require something like two months.

SPOKANE, WASH.—The capital stock of the Interstate Telephone Company is to be increased to $500,000 to provide funds for building extensions to the present lines of the company. It is semi-officially stated that when new lines now contemplated are completed the Interstate company will have an extensive system in Washington, Idaho and Oregon.

SPOKANE, WASH.—A. D. Campbell, manager of the Western Union system, announces that with the installation of the new equipment this month the company will have the largest gravity system in the United States. Thirty dynamo machines are being installed in the company's new quarters in the Wolverton Building. The company has 5,000 batteries in its Spokane office.

READING, PA.—All work has been completed on the rural telephone and telegraph line running from Kutztown to Kempton, and the system is now in operation. It passes through the following villages: Dietrich's Mill, Liscum, Stein's Distillery, Krumsville, Wesnersville and Kempton. It is the intention of the company to extend the line, in the near future, a distance of three miles beyond Kempton, and requests have been made that it be extended to Grimsville, New Smithville and Claussville.

ALBANY, N. Y.—Arrangements have been completed for the transfer of the stock of the Commercial Telephone Company, of Troy, to the United Message Company, and the sale will take place on October 10. A guarantee deposit of $5,000 has been made by the purchasing company. The stock will be purchased on this basis: $42.50 per share for the $50 shares and $85 per share for the $100 shares of preferred stock, and $15 for the $50 shares and $30 for the $100 shares of the common stock.

CARLYLE, ILL.—The Clinton County Telephone Company has sold its entire system in Clinton county to the Citizens' Telephone and Telegraph Company for $11,000. It will be operated in connection with the Central Union company, which gives a long-distance service. The officers of the new company are: Hugh V. Murray, of Carlyle, president; Henry Schurman, Germantown, vice-president; B. H. Donne, Breese, secretary; August Klutho, Breese, treasurer. A network of lines through the county will soon be completed.

HARTFORD, CT.—The new exchange at Deep River has been opened by the Southern New England Telephone Company. There will be four new circuits into Essex and two into Ivoryton, relieving the congested conditions that have existed in the service in that territory. There will also be five new trunk lines into Saybrook and one for Middletown. The new exchange will have forty-six lines, carrying 146 subscribers at the outset. The district will comprise Deep River, Winthrop, Chester, Hadlyme in East Haddam, and fourteen stations in the town of Lyme.

SPOKANE, WASH.—Official announcement is made by Robert M. Tucker, president of the Empire Electric Company, that the plant for the Home Telephone Company in Spokane will be completed as rapidly as possible. The building will be 70 by 100 feet, four stories high, of reenforced cement faced with white pressed brick and terra-cotta trimmings. It will cost $70,000, in addition to which amount the company will expend $300,000 for equipment. The company is an independent concern, and will have connection with the Puget Sound country and various towns and cities in the Inland Empire.

BIG FALLS, MINN.—Big Falls now has telephonic communication with the outside world through the medium of a local telephone exchange in connection with a long-distance line constructed by the Northwestern Telephone Exchange Company. Charles Swedback secured the franchise for installing a local telephone exchange. Long-distance connection with Bemidji and other towns through the Northwest was desired by local business men, and an appeal was made to the northwestern people to build a line that would connect with the Big Falls exchange. The long-distance line extends northward from Bemidji only as far as Blackduck at present.

LOS ANGELES, CAL.—The Home Telephone Company, of Santa Barbara, has organized an affiliated company for the purpose of building a line to Santa Maria. This will be a part of the long-distance system to San Francisco, and the city of Santa Maria will be occupied also by a local exchange. The articles of incorporation of the Home Telephone and Telegraph Company, of Santa Barbara county, have been filed with the county clerk. The company is incorporated for $200,000, of which $10,000 has been subscribed, twenty shares each by Paul O. Tietzen and Robert E. Easton, of Santa Maria, and by George S. Edwards, Harry W. T. Ross and Edward F. R. Vail, of Santa Barbara.

ELECTRIC LIGHTING.

TALLAPOOSA, GA.—An electric light plant has been placed in operation in Tallapoosa.

CANTON, OHIO—Extensive additions to the lighting system of Canton have been completed.

ST. PAUL, MINN.—Fulda capitalists will put in an electric light plant at Howard, S. D.

FREMONT, OHIO—The Yaryan Company has received 150 new arc lamps, which it is installing in the city streets.

FRANKLIN, N. Y.—An electric light plant is to be installed at Franklin, the work to be completed by November 1.

COMPTON, CAL.—A new electric light plant, under the management of G. R. Fulton, is to be established at Compton.

CINCINNATI, OHIO—The city council has confirmed the lease of the Cincinnati Gas and Electric Company to the Union Gas and Electric Company.

ELLENVILLE, N. Y.—The village board of trustees has granted to Dwight Divine & Son, a franchise to erect poles within the village to convey electric light, power and heat.

LADYSMITH, BRITISH COLUMBIA—The proposed by-law for the borrowing of the sum of $35,000 for the purpose of installing an electric light plant in Ladysmith was defeated.

LORAIN, OHIO—Dissatisfied with the lighting service of the local illuminating company, the board of public service is contemplating the establishment of a municipal lighting plant.

WEST SENECA, N. Y.—At a meeting of the West Seneca town board, a franchise was granted to the Niagara, Lockport & Ontario Power Company, for twenty-five years. The company has contracted to furnish electric lights to the village at $56 each per year.

GRASS VALLEY, CAL.—This city is contemplating the advisability of installing a municipal lighting plant. It is estimated that such a plant would cost about $80,000. At present the city is paying $4,000 per year for lights.

BUTLER, N. J.—Butler is to have an electric lighting system. At a meeting of the mayor and council a franchise was granted the Bellman & Sanford Electric Lighting Company, of New York, to install a plant in the borough.

SULPHUR, I. T.—The Sulphur Light and Power Company is about to issue $50,000 bonds for the purpose of enlarging its plant. The company has been in operation for about a year, and has grown rapidly, necessitating the proposed enlargements.

WEISER, IDA.—The Idaho Light and Power Company, the new organization which contemplates installing electric lights in Payette, Weiser and Ontario, is now pushing the work of securing the remainder of the right of way for its power ditch. The power-house will be located about four miles above Payette.

EDWARDSVILLE, ILL.—Deeds have been filed transferring the property of the Edwardsville light and power company and the Granite City-Venice Electric Light Company to the Madison County Light and Power Company, the latter company having been recently incorporated by the McKinley syndicate.

COHOES, N. Y.—The Hudson River Electric Power Company has purchased the extensive coal yards and sheds owned by Thomas B. Golden. The land is desired as a site for the erection of a large building which will be used as a transforming station by the company. The structure, it is expected, will cost at least $50,000.

WALLINGFORD, CT.—At a special meeting of the voters, called for considering the advisability of adding to the electric lighting plant, it was voted to appropriate $8,500 for extending and enlarging the plant and to issue bonds to raise $5,000 of that amount, the same to be payable a year from date of issue. Although it was voted to appropriate $8,500, thus making the total amount available for making the improvements $14,000, yet the electric commissioners stated that it was very probable that the total expenditure would not exceed $12,000. Part of the amount that is to be expended will come from the surplus earnings. The new extensions to the plant will consist of a water-wheel, generators and other appliances, in addition to those voted for last April.

PITTSBURG, PA.—Mechanical improvements, aggregating many thousands of dollars, have enabled the Allegheny County Light Company and all subsidiary companies to reduce the prices on electric light furnished commercial and domestic consumers. This reduction ranges from sixteen per cent on business houses to thirty per cent on dwellings, and goes into effect on October 1.

ESCANABA, MICH.—A lighting plant proposition has been submitted to the Escanaba council by A. C. Runyan, president of the Light, Heat and Power Company, of South Haven, Mich. He desires to purchase the municipal lighting plants and offers $70,000 for them, provided the city will grant him a thirty-year franchise, and agrees to furnish arc lights to the city for $65 a year.

BUFFALO, N. Y.—The transmission line by which the Niagara, Lockport & Ontario Power Company will convey Niagara Falls electrical power to the Lackawanna steel plant is nearing completion. It was announced that the steel plant will be using Falls power within thirty days. The steel plant is spending about $200,000 on its electrical equipment. The power will be delivered to the Lackawanna company at 60,000 volts.

BATTLE CREEK, MICH.—The Commonwealth Power Company, which furnishes the electric power for the Battle Creek city electric lines and the interurban lines, is buying the right of way for a new high-tension line from Allegan to Augusta, through Richland, it being an air line. The line will not run on the highway, but the company will buy the right of way across farms, and instead of placing the wires on high poles will suspend them on steel derricks.

BELVIDERE, N. J.—Capitalists of Albany are interested in a project to tap the Delaware river at a point near Smith's Hotel, on the Pennsylvania side of the river, a short distance above Belvidere, and divert the water for electrical purposes, carrying it through a canal four miles to the foot of Big Foul Rift, at which point the power-house will be built. It is reported that the power will be used for trolley and electric lighting purposes. The water will be returned to the Delaware at Rocksburg, N. J.

RICHMOND, KY.—Cincinnati capitalists have secured an option on the Richmond Electric and Power Company until October 1. It is understood that it is the intention of the parties taking this option to extend the wires from Richmond to Berea, which is fifteen miles south, and which has a population of nearly 2,000. The route for the wires will be out the Big Hill pike. They will run through Rogersville, Kingston and Bobtown. All of these places, together with all residences along the way, will be furnished with light.

GRAND RAPIDS, MICH.—Final arrangements have been completed for the organization of a new light and fuel company at Stoughton, Wis., in which Grand Rapids capital is interested. The company will be known as the Stoughton Light and Fuel Company and the following officers have been elected: Andrew Fyfe, president; Henry M. Wallace, vice-president; Raymond B. West, secretary, and Raymond J. St. John, treasurer. The stock issue is $85,000 and the bond issue a similar amount, for which the Michigan Trust Company is trustee.

ALEXANDRIA, VA.—The Alexandria Electric Light Company, to which the franchise for supplying this city with electricity for light and power was recently awarded by the council, is said to have purchased the property of the Osage Manufacturing Company, on South Union street. The property has been involved in litigation for some time past, and, it is stated, has been purchased subject to the approval of the court. The amount paid for the property has not as yet been made public. There are several buildings on the land at present, which may be utilized by the electric company. The new electric plant, which, as has heretofore been stated, is to cost in the neighborhood of $75,000, will, it is expected, be erected and in operation before the end of the present year. Edward E. Mandeville, of Philadelphia, is the secretary of the company, which has been chartered under the laws of Virginia. The award of the franchise was made in the name of Mr. Mandeville, who organized the company.

ELECTRICAL SECURITIES.

The stock market for some time has been irregular and indecisive, and with price changes fluctuating over considerable margins. The dealings have been active, resulting in sharp rallies in certain issues, with reactions in others. It is understood that there are a number of large interests behind the bull sentiment, and that sufficient strength will be displayed and maintained to keep the level of the market generally high. Were it not for the restraining force exerted by monetary considerations, it is quite possible that a mild inflation would ensue. The August statement of foreign trade was very good, showing a considerable improvement over the July report. There is no change in the general industrial outlook, business activity continuing to show record proportions, as indicated by railroad earnings, bank clearings and similar data.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 22.

New York:	*Closing.*
Allis-Chalmers common	16¾
Allis-Chalmers preferred	40
Brooklyn Rapid Transit	79½
Consolidated Gas	139
General Electric	165½
Interborough-Metropolitan common	38
Interborough-Metropolitan preferred	77¾
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	73
Mackay Companies (Postal Telegraph and Cables) preferred	71
Manhattan Elevated	142¼
Metropolitan Street Railway	107
New York & New Jersey Telephone	127
Western Union	86
Westinghouse Manufacturing Company	153

The regular quarterly dividend of 1¾ per cent on the stock of the Metropolitan Street Railway Company is payable October 15. Books closed September 24 and will reopen October 16.

Directors of the Westinghouse Electric and Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on its preferred, assenting and non-assenting stocks, payable October 10 to stock of record September 26. Books closed September 26 and will reopen October 11.

The semi-annual interest on the registered collateral trust 4½ per cent gold bonds of the Interborough-Metropolitan company, and coupon No. 1, from the coupon bonds, due October 1, 1906, will be paid on or after that date, at the office of Windsor Trust Company, 65 Cedar street, New York city. The books of the company for the registration of bonds will remain closed from Friday, September 28, to Monday, October 1.

The income account of the Interborough Rapid Transit system for the year ended June 30, 1906, includes for the first time earnings for a complete year of the subway division. The income account of the system for the previous year included earnings of the subway division only from October 27, 1904, to June 30, 1905. The gross earnings of the system (elevated and subway) for the year were $19,695,594, an increase compared to the previous year of $2,858,224, equal to 16.97 per cent. The total income amounted to $12,010,273, an increase for the year of $2,079,247, equal to 20.93 per cent. After payment of charges, including a dividend of 7 per cent on Manhattan Railway stock, the surplus amounted to $3,168,890, an increase of $748,969, equal to 30.96 per cent. The profit and loss surplus for the year, after dividend payments, was $281,390, against $57,421 for the previous year. As was expected the earnings of the Manhattan elevated division were less than for any year since 1903. The decrease for the year compared to the previous year was $403,572, or 3 per cent. The decrease for the year compared to the earnings for 1904 was $1,392,964, or 9.8 per cent.

Boston:	*Closing.*
American Telephone and Telegraph	137¾
Edison Electric Illuminating	235
Massachusetts Electric	71
New England Telephone	129
Western Telephone and Telegraph preferred	85

Dividend action by American Telephone directors has been deferred until October 2, by which time President Fish is expected back from Europe.

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8⅜
Philadelphia Rapid Transit	29½
United Gas Improvement	86½

The directors of the Electric Storage Battery Company have declared a dividend of 1¼ per cent from the net earnings of the company, on both common and preferred stocks, payable October 1, to stockholders of record at the close of business on September 25.

The report of the Philadelphia Rapid Transit Company for the year ended June 30 shows as follows: gross, $17,483,144; expenses, $9,153,603; net, $8,329,541; other income, $193,103; total income, $8,522,644; taxes and license, $1,075,216, leaving a balance of $7,447,428. Deducting charges of $7,143,431, there remains a surplus of $303,997, as compared with $108,210 for the previous year. The number of passengers carried was 448,576,785. At the annual meeting of stockholders of the Philadelphia Rapid Transit Company, Henry Phipps was reelected for a term of four years, and August B. Loeb was elected a director to take the place of John M. Mack, resigned.

Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	145
Metropolitan Elevated preferred	66½
National Carbon common	85
National Carbon preferred	117
Union Traction common	5
Union Traction preferred	20

The Union Traction Company has ordered 200 cars, to cost $1,000,000.

The Metropolitan Elevated directors at their monthly meeting did not act on the dividend.

The Northwestern Elevated has issued its report for the year ended June 30, 1906. The income account shows as follows: gross, $1,948,727; expenses, $705,572; net, $1,243,155; charges, taxes, etc., $962,650; surplus, $280,499, equal to 5.6 per cent on the $5,000,000 preferred stock. The average daily increase in passengers carried was 6,356, equal to 8.65 per cent. The ratio of operating expenses, including maintenance reserve, to earnings was 46.62 per cent. Ratio of operating expenses, maintenance reserve, loop account and taxes to earnings was 62.72 per cent. All the retiring directors were reelected.

DATES AHEAD.

American Electrochemical Society. New York city, October 8 and 9.

American Society of Municipal Improvements. Birmingham, Ala., October 2-4.

American Society of Mechanical Engineers. New York, N. Y., December 4-7.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association. Columbus, Ohio, October 15-19.

Empire State Gas and Electrical Association. New York city, October 12.

Kansas Gas, Water and Electric Light Association. Lawrence, Kan., October 16-17.

Michigan State Electric Association. Grand Rapids, Mich., October 10-12.

National Machine Tool Builders' Association. New York city, October 23-24.

Old Time Telegraphers' and Historical Society. Washington, D. C., October 9, 10 and 11.

Railway Signal Association. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

OBITUARY NOTES.

MR. MARTIN F. MURPHY, a financier and business man of Renovo, Clinton county, Pa., died suddenly at Philadelphia, Pa., on September 17. Mr. Murphy was fifty-eight years old, and was reputed to be the wealthiest man in Clinton county. He was one of the pioneer settlers there and one of the founders of Renovo. At the time of his death he was a director of the First National Bank, of Renovo, a director of the Edison Heat and Light Company, owner of the Ridgway Sand and Stone Company, and of the Steam Heat Company, all of Renovo.

MR. P. F. KOBBE, a director of the Westinghouse Electric and Manufacturing Company, died at his country place, "Hillfield," Stockbridge, Mass., on Friday, September 21. Mr. Kobbe had been ill for some time and his death was not unexpected. He was born in New York, October 24, 1842, and was educated in Germany. He served in the Civil War as a member of the Seventh Regiment. He became interested in electricity and was connected with the United States Lighting Company when it was absorbed in 1890 by the Westinghouse company. Mr. Kobbe was then elected vice-president and treasurer of the Westinghouse corporation. He was also identified with the British and French Westinghouse Companies and with other Westinghouse interests. He was a member of the Calumet and Richmond County Country Club and the Society of Colonial Wars. He is survived by a widow and five children.

MR. T. E. HAMBLETON, who for half a century had been a familiar figure in Baltimore business and banking circles, died at his home, "Hambledune," near Lutherville, Md., at 12.50 P. M., Friday, September 21. Mr. Hambleton was called the father of rapid transit in Baltimore. He bought the old People's Line at auction and spent large sums of money in bringing it up to the requirements at the time. He next induced the Widener-Elkins syndicate, of Philadelphia, to become interested in Baltimore, and finally brought about the amalgamation of all the street car lines. Another big project in which Mr. Hambleton was actively interested was the building of the West Virginia Central & Pittsburg Railroad and the Piedmont & Cumberland Railroad, the financing of both properties being handled by his house, the banking firm of Hambleton & Company. These properties are now owned by the Gould interests. Mr. Hambleton also financed the various Baltimore gas companies, which have since been consolidated. He was seventy-seven years of age, and a native of Maryland.

PERSONAL MENTION.

MR. FRANK D. LAWRENCE, the well-known president of the F. D. Lawrence Electric Company, Cincinnati, Ohio, was a visitor to New York city last week.

MR. H. MOZEN, of Atlanta, Ga., has succeeded T. M. Sommerkamp, of Columbus, as manager of the Columbus, Ga., exchange of the Southern Bell Telephone Company.

MR. S. L. WHEELER, superintendent of the fire and police telegraph at Springfield, Mass., an old-timer who has been many years in the industry, was a visitor to New York city last week.

MR. E. H. RICHARDS, formerly assistant superintendent of the Boston & Worcester Street Railway Company, has been placed at the head of the Newport, R. I., division of the Old Colony line.

MR. H. E. WELLS has been appointed to look after the interests of the Buckeye Electric Company, Cleveland, Ohio, in the South, and has opened an office in Dallas, Tex., located at 216 Commerce street.

MR. H. H. CARR, of Newport News, Va., has been appointed general manager of the Raleigh (N. C.) Street Railway Company, this being the initial step in a movement to generally rehabilitate the system.

MR. THOMAS M. KEELEY, formerly superintendent of the Michigan United Railways, has been appointed general manager of the Michigan Heat and Power Company, with headquarters at Lansing, Mich.

MR. CHARLES E. BROWN, of the Central Electric Company, Chicago, Ill., was a visitor to New York city last week. Mr. Brown reports a busy summer and expectations of a heavy demand for all kinds of material for the fall and winter.

MR. GEORGE A. COLE, of the John A. Cole Company, 776-770 Folsom street, San Francisco, Cal., was a visitor at Niagara Falls during the recent electrical gathering there, and since that time has been in New York and other eastern cities.

MR. PAUL LUPKE has been appointed editor of the Question Box of the National Electric Light Association, and has already begun the preliminary work. Mr. Lupke was in charge of this department and presented a particularly efficient report to the Atlantic City convention. It is believed that the 1907 Question Box will be far in advance of its predecessors.

DR. JOHN TROWBRIDGE, professor of physics at the Jefferson Physical Laboratory, Harvard University, who for a number of years has been a painstaking laborer in research work, and who has contributed many valuable essays and treatises on the subject of electrical and physical phenomena, celebrated his seventy-ninth birthday at his home in Arlington, Mass., on September 18. Dr. Trowbridge is in the best of health.

MR. GEORGE GRAY WARD, vice-president and general manager of the Commercial Cable Company, was a passenger on the Pacific Mail steamer Mongolia, which went on a reef on Midway Island in the north Pacific, on Sunday, September 16. The steamship was about to land passengers at Midway Island when she went aground. The passengers were taken off the ship and landed on the island, and on the morning of September 21 the vessel was floated. Mr. Ward will very likely reach San Francisco via the transport Buford, which was due to arrive at Midway on September 21.

MR. G. R. NEWCOMER, district manager for the Middle West for the Brilliant Electric Company, Cleveland, Ohio, has been appointed assistant to General Manager E. J. Kulas, with headquarters at Cleveland, Ohio. The business of the Brilliant Electric Company has been so great during the past season that this rearrangement of the personnel is necessary. M. E. V. Hennecke, the direct representative in charge of the tantalum and "Gem" lamp department, has been in the Far West for some time, and is meeting with remarkable success in the placing of large orders for these high-efficiency lamps.

INDUSTRIAL ITEMS.

THE RUST BOILER COMPANY, of Pittsburg, Pa., has secured the order for the boilers for the United States Steel Corporation's new plant at Gary, Ind., the order being for sixteen 400-horse-power Rust water-tube boilers.

THE A. & W. ELECTRIC SIGN COMPANY, Cleveland, Ohio, will send its illustrated catalogue to parties interested in electric sign propositions. This company has designed a system of sign lighting for which many features of economy and utility are claimed.

THE BALL ENGINE COMPANY, Erie, Pa., has published a handsome souvenir catalogue dealing with its achievements during the past twenty-five years. The story is entitled, "A Quarter of a Century Building High-Grade Steam Engines and Nothing Else."

THE H. KRANTZ MANUFACTURING COMPANY, 160-166 Seventh street, Brooklyn, N. Y., will be pleased to send a copy of bulletin No. 19 to any one interested in switchboards, switches, panel-boards and outlet boxes. This bulletin gives dimensions, illustrations and prices on type H knife switches, fuse blocks and terminals made by the company.

THE SAFETY ARMORITE CONDUIT COMPANY, Pittsburg, Pa., has hit upon a neat advertising souvenir in the form of a match safe decorated with a celluloid strip which forms a ten-year calendar. This souvenir is neat in appearance, of practical value as a match receptacle, and of great utility as a ready-reference calendar.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is distributing a handsome series of blotters to the various jobbing houses and also to prospective customers. These include the "International," the "College Girl" and the "Famous Paintings" series. The company will be glad to take up the matter with jobbers who are interested in this form of advertising in connection with its various products, which include Allen soldering sticks, "Sun" solder-

ing sticks, "Samson" soldering sticks, Allen soldering paste, Allen soldering salts, Allen commutator lubricant and Allen liquid flux.

THE MARSHALL ELECTRIC MANUFACTURING COMPANY, Boston, Mass., will send samples of its new push-button switch with fibre plate to any interested architects, engineers and contractors, without charge. The company is now carrying in Boston, New York and Chicago over 200,000 sockets, including some thirty different special finishes, and can make prompt shipment from any of these stocks.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., has ready for distribution the following literature: circular entitled, "Twelve Timely Telephone Topics," which is being mailed to the various telephone exchanges throughout the country; booklet "148-AA," covering intercommunicating telephones used in connection with telephone exchanges; bulletin "151-A," covering various types of electric bells, particularly the water-tight and high-voltage bells which the company offers as something new, and also illustrating the new "return call" bell and button; bulletin "154," covering automatic gas lighting apparatus; bulletin "203," describing transmitters, transmitter arms and induction coils; bulletin "301-A and 305-A," covering type E enclosed and semi-enclosed motors and small direct-current motors and dynamos respectively. Any of these may be secured upon request.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., announces that the sales of its staples and cleats to the smaller telephone companies, both Bell and independent, are beginning to increase rapidly. These companies are realizing that although the first cost of the staples is greater than that of bare staples, different kinds of tacks or other forms of metallic insulated wire supports, they are economical in the end. The use of the Blake insulated staple prevents numerous short-circuits, grounds in wiring and circuit interruptions which are not only expensive to find, but annoying to the telephone subscriber. The business of the company in these articles has so increased in Canada that an agency has been established there by the Norton System Telephone Manufacturing Company, of Toronto and Halifax.

THE NATIONAL BRAKE AND ELECTRIC COMPANY, Milwaukee, Wis., announces the following recent orders for National air-brake equipments: Chicago City Railway Company, Chicago, Ill.; United Railways of San Francisco, San Francisco, Cal.; Oakland Transit Company, Oakland, Cal.; Spokane Traction Company, Spokane, Wash.; Metropolitan Street Railway, Dallas, Tex.; Rapid Transit Railway Company, Dallas, Tex.; Dallas Consolidated Railway Company, Dallas, Tex.; San Diego Electric Railway Company, San Diego, Cal.; Worcester Consolidated Street Railway Company, Worcester, Mass.; Michigan United Railways, Kalamazoo, Mich.; Twin City Rapid Transit Company, Minneapolis, Minn.; Chattanooga Railways Company, Chattanooga, Tenn.; York Street Railway Company, York, Pa.; Memphis Street Railway Company, Memphis, Tenn.; Birmingham Railway, Light and Power Company, Birmingham, Ala.; Knoxville Railway and Light Company, Knoxville, Tenn.; Pensacola Electric Terminal Railway Company. All orders for the above roads have been taken within the last thirty days, during which time this apparatus has been on the market and approximate 400 equipments.

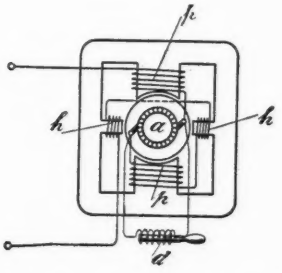
Record of Electrical Patents.

Week of September 18.

831,071. SAFETY DEVICE. George H. Hill, Montreal, Quebec, Canada, assignor of one-half to Michael Joseph Doherty, Montreal, Canada. Filed July 7, 1902. A circuit-breaker having two current coils, one for each side of the circuit, which, through relays and a third coil, actuate the breaker.

831,089. GRAB-BUCKET. John A. McGrew, Columbus, Ohio. Filed August 10, 1905. The scoops are operated by motors mounted on the bucket-hood.

831,101. DEVICE FOR SINGLE-PHASE COLLECTOR-MOTORS WITH COMPENSATION WIRING. Rudolf Richter, Wilmersdorf, near Berlin, Germany, assignor to The Siemens-Schuckert Werke G. M. B. H., Berlin, Germany. Filed November 21, 1905. A circuit of variable reactance is connected in parallel with the armature of an alternating-current commutator motor.



831,101. DEVICE FOR SINGLE-PHASE COLLECTOR-MOTORS WITH COMPENSATION WIRING.

831,131. MULTICONDUCTOR CABLE. Walter C. Yeatman, Chicago, Ill., assignor to American Telephone and Telegraph Company. Filed June 13, 1903. A four-stranded conductor, the two pairs of strands being twisted in opposite directions.

831,168. INSULATOR. Arthur J. L. Lembeck, Sioux City, Iowa, assignor of one-half to John P. Wall, Sioux City, Iowa. Filed November 26, 1904. Two heads are provided placed at right angles.

831,180. FREQUENCY METER. Edward McGarvey, Bellefonte, Pa. Filed December 7, 1904. A meter of the vibrating reed type.

831,186. ELECTRIC HEATING UNIT. Earl H. Richardson, Ontario, Cal., assignor to Pacific Electric Heating Company, Los Angeles, Cal. Filed December 19, 1905. A method of winding, giving substantially uniform thickness and length to the heater unit.

831,226. ELECTRIC CUTOUT. Frank B. Hinkson, New Castle, Pa. Filed March 25, 1905. The cutout is closed by the static pressure of a water pipe and opened when this becomes dynamic.

831,244. COMBINED MECHANICAL AND ELECTRIC MOTIVE POWER FOR TRAINS. George G. Schroeder, Washington, D. C. Filed April 17, 1905. The prime mover is geared to one axle and an electric motor to another, a dynamo being provided which may be driven by the engine.

831,269. STORAGE-BATTERY ELECTRODE PLATE. Thomas A. Edison, Llewellyn Park, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. Filed March 5, 1903. A plate for use in alkaline electrolyte, the pockets for the active material being made of metal of two thicknesses.

831,274. ELECTRIC SPARKING MECHANISM FOR EXPLOSIVE ENGINES. Hiram A. Frantz, Cherryville, Pa. Filed January 9, 1905. A sparker operated by a rocker-arm within the cylinder.

831,282. ARC LAMP. Alvin Hausold, Allegheny, Pa., assignor to Keystone Electric and Manufacturing Company, Pittsburg, Pa. Filed January 12, 1906. A method of constructing a carbon support.

831,284. PROTECTIVE DEVICE FOR VENTILATING-FANS. Robert A. Ilg, Chicago, Ill., assignor of one-half to Theresa Ilg, Chicago, Ill. Filed February 3, 1905. The motor is entirely surrounded by a hood which provides ventilation.

831,288. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed November 22, 1905. An improved system of simple telegraphy.

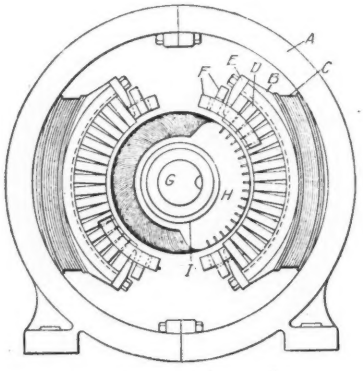
831,302. AERIAL ELECTRIC TRACKWAY. George G. Schroeder, Washington, D. C., assignor to Industrial Motor Company. Filed May 29, 1906. The track is supported so as to allow oscillatory and longitudinal movement.

831,304. ELECTRIC CONTROLLER. Charles C. Shedrick, Sherbrooke, Quebec, Canada. Filed August 12, 1905. Makes use of rocking contactors actuated by electromagnets.

831,311. LAMP SHADE AND PROTECTOR. Gregory Strootman, Buffalo, and Henry J. Caner, Rochester, N. Y. Filed January 26, 1906. The shade has a double-cone or hour-glass shape.

831,326. ELECTRIC FIXTURE. John H. Dale, New York, N. Y. Filed May 20, 1905. A bracket with a threaded adjustable clamp for taking different sizes of conduit.

831,327. POST AND BOX FOR CABLE TERMINALS AND THE LIKE. Benjamin F. Daly, New York, N. Y. Filed December 15, 1905. A post with a hollow base.



831,442. INDUCTOR-ALTERNATOR.

831,338. INSULATOR. Monroe J. Glick, Westfield, Ill., assignor to Jackson Rardin and Timothy Rardin, Westfield, Ill. Filed October 2, 1905. Two intercommunicating slots are provided, arranged at an angle.

831,348. TELEPHONE-RECEIVER SUPPORT. Frank F. Howe, Marietta, Ohio. Filed March 31, 1906. Provides adjustable supports for both receiver and transmitter.

831,355. TELEGRAPHIC TRANSMITTING DEVICE. Isidor Kitsee, Philadelphia, Pa. Filed June 21, 1906. Two opposing unequal sources of current are provided with means for shunting the stronger.

831,364. SELECTOR OR LOCKOUT FOR PARTY LINES. Alexis Marchand, Buckingham, Wash., assignor of one-half to James B. Valentine, Bridgeport, Wash. Filed September 5, 1905. Revolving contacts may be locked in position so as to cut out any subscribers.

831,376. RAILROAD SIGNALING. Petrus J. Portman, Amsterdam, Netherlands. Filed July 6, 1905. A source of current and a signal are provided on the vehicle, signals being communicated through auxiliary conductors.

831,383. PROTECTOR FOR INCANDESCENT GLOBES. Charles Schmidt, Allegheny, Fredrich Wunderlich, Pittsburg, and James A. Thibodeau, Turtle Creek, Pa. Filed January 12, 1906. A soft cap for protecting incandescent bulb tips.

831,396. PROCESS OF SEALING EVACUATED VESSELS. Willis R. Whitney, Alplaus, N. Y., assignor to General Electric Company. Filed March 8, 1905. Openings in the glass vessel are closed by metallic caps, pressed on when the glass is plastic.

831,400. ELECTRIC VAPOR LAMP. Howard I. Wood, Schenectady, N. Y., assignor to General Electric Company. Filed July 21, 1902. A switch connected to an auxiliary electrode is placed within the tube.

831,401. VAPOR ELECTRIC APPARATUS. Howard I. Wood, Schenectady, N. Y., assignor to General Electric Company. Filed March 31, 1904. All electric connections are made through one end of the tube.

831,404. CONTROLLING SWITCH. Henry P. Ball, New York, N. Y., assignor to General Electric Company. Filed February 23, 1905. The controlling switches automatically lock one another.

831,412. TROLLEY WHEEL. John Brown, Camden, N. J. Filed December 16, 1905. Auxiliary wheels provide two extra grooves.

831,430. INCANDESCENT LAMP SOCKET. James J. Hartley, Schenectady, N. Y., assignor to General Electric Company. Filed April 27, 1905. A method of construction.

831,434. WATER-PURIFIER. Frank B. Hinkson, New Castle, Pa., assignor to Hinkson Electric Liquid Purifying Company, Pittsburg, Pa. Filed October 7, 1905. An electrolytic purifier.

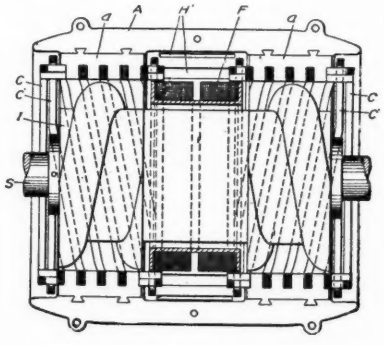
831,442. INDUCTOR-ALTERNATOR. Charles A. Kelsey, Pittsfield, Mass., assignor to Stanley-G. I. Electric Manufacturing Company. Filed July 6, 1905. The armature coils and revolving inductors are arranged helically.

831,446. ALTERNATING-CURRENT MOTOR. Marius C. A. Latour, Paris, France, assignor to General Electric Company. Filed January 21, 1905. The brushes are lifted from the motor commutator at a given speed without changing the electrical connections.

831,451. SYSTEM OF MOTOR CONTROL. Charles E. Mandelick, New York, N. Y., assignor to Sprague Electric Company. Filed December 19, 1905. A motor circuit controlled by a relay permits the operation of a number of controllers.

831,467. TROLLEY HEAD. William H. Pfrimmer, New Albany, Ind., assignor of one-sixth to Jacob W. Roberts and one-sixth to David E. Jones, New Albany, Ind. Filed November 2, 1905. Provided with rotating disc guards, spring-mounted.

831,475. INDUCTOR-ALTERNATOR. David B. Rushmore, Schenectady, N. Y., assignor to General Electric Company. Filed October 5, 1905. The inductor has two helical projections and the armature coils are laid in helical slots.



831,475. INDUCTOR-ALTERNATOR.

831,478. METERING SYSTEM. Ernest Schattner, Schenectady, N. Y., assignor to General Electric Company. Filed August 19, 1905. The action of the damping system is controlled by a centrifugal governor.

831,482. ELECTRIC HAMMER. Robert Smith, Middletown, Ohio. Filed August 8. 1905. The blow is delivered by a spring compressed by means of an electromagnet.

831,490. ELECTRIC CIGAR LIGHTER. Julius C. Tournier, Schenectady, N. Y., assignor to General Electric Company. Filed September 25, 1905. A method of construction.

831,509. TROLLEY. Jacob T. Haudenshield, Scott township, Allegheny county, Pa. Filed November 10, 1905. The wheel is mounted on an oscillating form.

831,525. COMPOSITE TELEPHONY AND TELEGRAPHY. Harry O. Rugh, Chicago, Ill., assignor to Western Telegraphone Company, Minneapolis, Minn. Filed January 13, 1903. A shunt is placed around the telephone, having low resistance, but high impedance.

831,526. SIGNALING APPARATUS. Harry O. Rugh, Chicago, Ill., assignor to Western Telegraphone Company, Minneapolis, Minn. Filed January 8, 1904. Makes use of a polarized relay for controlling the signal bell.